KNOWLEDGE.

VOL. IV.

KNOWLEDGE

AN ILLUSTRATED

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PLAINLY WORDED—EXACTLY DESCRIBED

CONDUCTED BY RICHARD A. PROCTOR.

"LET KNOWLEDGE GROW FROM MORE TO MORE."—*Tennyson.*

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A NATURALIST'S YEAR.

By GRANT ALLEN.

XVI.—ABOUT VARIATION.

STROLLING along the lane by the mill-stream this afternoon, I see with a shudder that the epilobes and the St. John's worts are coming out in blossom again for the season, and I feel dimly conscious in my own heart that the annual task of trying to sort them out decently into well-marked divisions will recur once more in full tediousness. They are a hopeless set of interlacing species, these weedy, wayside summer flowers; a perfect chaos of gradually-merging characteristics, each supposed kind shading off imperceptibly into the next through infinitesimal and imperceptible gradations. Of course, I am personally quite convinced that the effort to introduce an artificial separation where Nature still keeps up an unbroken series is really as absurd as it is futile: but the superstitions of the systematists die hard, and I feel in duty bound to settle in my own mind to which particular bundle of his arbitrary groups a conscientious technical botanist would consider himself at liberty to refer this, that, or the other particular epilobe, or hypericum, or hawkweed. The thing doesn't really matter in the least, being only a question of human naming, not a question of genuine natural distinctness; but if one leaves it undone, one has an unpleasant sense of a social duty unperformed, and an important dogma in the Athanasian creed of conservative science imperfectly understood.

It is in great part the general want of knowledge as to the close way in which many large groups of species thus interosculate that makes most people hesitate so much about accepting the simple truths of evolutionism. The animals with which they are best acquainted—and most people look at the matter from the standpoint of animal life alone—are a few big mammals, all readily distinguishable from one another, at least here and now, and with few remaining intermediate links to bridge over the gaps between them. Nobody is in any danger of mistaking a cow for a sheep, or even a horse for a donkey; and the various tarpans, and onagers, and quaggas, and zebras, which span the gulf in the last instance and do really merge into one another very indefinitely, are only to be seen in the Zoological Gardens, or else in Tartary, Central Africa, and other reasonably inaccessible parts. But when we come to examine all the known species of any great group, especially among plants, the real difficulty is often not to find intermediate links, but to discover any well demarcated lines of division, or any constant assemblage of characters marking the artificial bundles into which we choose to distribute them. Our English flora is a small and fragmentary one, so that this difficulty is not felt within its narrow limits so greatly as when we examine wider areas; but whenever one comes to compare together a large number of specimens from all parts of the world, it is wonderful how extremely elusive is the task of species-making. True species do often undoubtedly exist: that is to say, there are certainly many groups in which the various existing individuals fall naturally into well-marked divisions, all the intervening types having been killed out by the competition of the better-adapted specific forms, as Mr. Darwin has pointed out. Still, many other groups, perhaps almost as numerous (among plants, at least), do also exist, in which there is no such distinct demarcation of species: the various typical forms merge on either side into one another by every possible intermediate variation. Perhaps these are instances of species in the making; perhaps they show us that primitive plastic state during which variations have not yet become fixed and definite; but, in any case, there they are, and even the most rigorously orthodox botanists can hardly deny their existence.

The local British interest of the epilobes, the St. John's worts and the hawkweeds, consists in the fact that they display just this close interosculation of species even within the range of our own narrow English flora. On the one hand, nobody could fail to recognise the difference between some of the most distinct types—for example, the great purple willow herb, or the pretty pink rose-bay, as compared with the hoary epilobe and the square epilobe of our wayside ditches; or again, the great St. John's wort of our gardens, bearing flowers three or four inches in diameter, as compared with the scrubby, small-flowered *Hypericum dubium* and *Hypericum quadrangulum*, that line our dusty country roads. But, on the other hand, if one attempts to divide them all up into distinct species, one finds oneself hampered by all kinds of intermediates, which make the definite classification of the text-books practically impossible in actual practice. Indeed, the text-books themselves all differ as to the number of species they admit; and though some botanists will at once decide off-hand by what name they would call a particular specimen, there are other wiser and more cautious authorities who will not thus commit themselves to a fixed and dogmatic nomenclature. I turn to Dr. Bentham on these very epilobes, and I find he truly remarks: "The numerous forms the species assume in every variety of climate make it exceedingly difficult to define them upon any certain principle, and botanists seldom agree as to the number they should admit. Those here adopted are the most marked among our British forms; but it must be confessed that in some instances intermediates are to be met with which will be found very puzzling." He then goes on to say that in all cases the style should be carefully observed when fresh, in order to see whether it is entire or four-lobed; but even this distinction, upon which he bases his table of species, is a very unimportant one; for in most epilobes the four lobes of the style are joined in a club-shaped head at an early stage in the bud, and only open as the flower matures; while even in those species where they never open, the marks of the four cohering lobes may be easily seen with

a small pocket lens. The opening is, in fact, merely one of the ordinary devices to prevent self-fertilisation; it is found in all the larger and handsomer British species, which specially lay themselves out to attract insect visitors, while it is wanting in the smaller and less conspicuous varieties. Nor is this all, for in the little intermediate type, known as *Epilobium roseum*, the lobes sometimes open shortly, and sometimes remain closed in a club-shaped stigma; and I have found flowers in both states growing together on the same plant.

A rapid glance at the various forms assumed by British representatives of this Protean genus will help better than any amount of generalised talk to explain exactly how closely the different groups resemble one another. Omitting the naturalised French willow or rose-bay (which I do not believe to be truly indigenous anywhere in Britain), we have four fairly distinct central types of native epilobes, as it seems to me, usually distributed into from seven to eleven or more recognised species. Of these the largest, handsomest, and, on the whole, most marked type, is the great purple-red willow-herb (*Epilobium hirsutum*), with a bunch of very big and showy flowers. This is the great insect-fertilised form, laying itself out most for attractive display, and having the stigma deeply four-lobed. Below it comes the so-called broad epilobe (*E. montanum*), differing from it, in good typical specimens, by its stalked and rounded leaves, while those of the willow-herb are longer, narrower, and more sessile on the stem, as well as by its much smaller and pinker flowers, still, however, with a four-lobed stigma. This is a less luxuriant form of the same general type, growing in dry situations, while the willow-herb affects moist ditches; and it shows some signs of incipient degeneration in its short petals, sometimes twice as long as the calyx, but often only of about the same length. These two forms are universally admitted as distinct. But intermediate between them come the specimens known as *E. parviflorum*, some of which closely resemble the willow-herb in leaves and flowers, while others approach very near to *E. montanum*. So far as my observation goes, in very wet situations, they verge in the direction of the larger type, and in very dry ones of the smaller. I may add that dwarfed specimens of *E. montanum*, growing on the top of walls or other waterless spots, carry the characteristics of the small type to an extreme. But between these intermediates, even, it is possible to find yet other intermediates, approximating still more closely to the upper or lower forms. So much for the two main large-flowered types with four-lobed stigmas; next as to the two main small-flowered types, with a club-shaped style. One of these is a lowland form (*E. tetragonum*): the other is a low, tufty mountain plant (*E. alpinum*). But *E. tetragonum*, once more, which in very typical specimens is known by its square stem, marked with four decurrent lines, is linked to the four-lobed species by the intermediates known as *E. roseum*, some of which have the style club-shaped, while others have it slightly opened into four short lobes. This *E. roseum* itself merges into *E. montanum*, on the one hand, by the small-flowered dry-soil specimens mentioned above, through the shortly four-lobed form called *E. lanceolatum*, and into the regular *E. tetragonum*, on the other hand, by specimens with entire stigmas and marked decurrent lines. Other small differences, which I need not note here, have made some divergent plants of *E. tetragonum* be considered as specifically distinct, under the name of *E. virgatum*. Finally, the dwarf mountain type, *E. alpinum*, when growing under exceptionally favourable circumstances, by the banks of Highland streams, assumes longer and broader leaves, toothed on the edges, and recurs somewhat towards the lowland type, in which state it is known as *E. alsinæfolium;* while in boggy places on lower ground, it reverts towards the square-stemmed form, and receives the name of *E. palustre*. "It sometimes, also, comes very near the narrow-leaved forms of *E. roseum* and *E. tetragonum*," says Mr. Bentham, "but has the buds much more nodding, and the decurrent lines on the stem are either very faint or entirely wanting." For my own part, I have seen intermediate specimens between almost all these carefully-distinguished species or varieties which it would be mere juggling, in my opinion, dogmatically to refer to either or any type. But if ever the various intermediate forms are weeded out by the action of natural selection, there will probably remain four "good species," as systematists call them:—*E. hirsutum*, *E. montanum*, *E. tetragonum*, and *E. alpinum*.

This is rather a long, dull, and technical exposition, I am aware; but it will serve better than anything else to show how impossible is the attempt to draw definite lines in such very mixed and elastic families. Nor are these families by any means exceptional. To anybody who wishes for an insight into the variety and modifiability of plant forms even within the limits of a single small country, the careful comparative study of the following common English genera and species may be confidently recommended: the roses (*Rosa canina*, *R. arvensis*, &c. Mr. Bentham makes five species, and Mr. Babington, seventeen); the brambles (*Rubus*, from four to forty-five species recognised); the potentillas (including *Tormentilla* and the strawberry); the St. John's worts (*Hypericum*); the sow-thistles (*Sonchus*) and the hawkweeds (*Hieracium*). How any one can rise from a close comparison of the endless forms of hawkweed alone, a believer in strictly defined natural species, is one of those psychic mysteries only adequately to be explained by Mr. Bishop, or by Messrs. Maskelyne & Cooke.

THE CHEMISTRY OF COOKERY.

XIII.

By W. Mattieu Williams.

THE process of frying follows next in natural order to those of roasting and grilling. A little reflection will show that in frying the heat is not communicated to the food by radiation from a heated surface at some distance, but by direct contact with the heating medium, which is the hot fat commonly, but erroneously, described as "boiling fat."

As these papers are intended for intelligent readers who desire to understand the philosophy of the common processes of cookery, so far as they are understandable, this fallacy concerning boiling fat should be pushed aside at once.

Generally speaking, ordinary animal fats are not boilable under the pressure of our atmosphere (one of the constituent fatty acids of butter, butyric acid, is an exception; it boils at 314° Fah.). Before their boiling-point, *i.e.*, the temperature at which they pass completely into the state of vapour, is reached, their constituents are more or less dissociated or separated by the repulsive agency of the heat, new compounds being in many cases formed by recombinations of their elements.

When water is heated to 212° it is converted completely into a gas which gas returns to the fluid state without any loss on cooling below 212°. In like manner if we raise an essential oil, such as turpentine, to 320°, or oil of peppermint to 340°, or orange peel oil to 345°, or patchouli to 489°, and other such oils to various other temperatures,

they pass into a state of vapour, and these vapours when cooled, recondense into their original form of liquid oil without alteration. Hence they are called "volatile oils," while the greasy oils which cannot thus be distilled (in which animal fats are included), are called "fixed oils."

A very simple practical means of distinguishing these is the following:—Make a spot of the oil to be tested on clean blotting-paper. Heat this by holding it above a spirit lamp flame, or by toasting before a fire. If the oil is volatile, the spot disappears; if fixed, it remains as a spot of grease until the heat is raised high enough to char the paper, of which charring (a result of the dissociation above-named) the oil partakes.

But the practical cook may say "this is wrong, for the fat in my frying-pan does boil, I see it boil, and I hear it boil." The reply to this is, that the lard, or dripping, or butter that you put into your frying-pan is oil mixed with water, and that it is not the oil but the water that you see boiling. To prove this, take some fresh lard, as usually supplied, and heat it in any convenient vessel, raising the temperature gradually. Presently, it will begin to splutter. If you try it with a thermometer you will find that this spluttering point agrees with the boiling point of water, and if you use a retort you may condense and collect the splutter-matter, and prove it to be water. So long as the spluttering continues the temperature of the melted fat, *i.e.*, the oil, remains about the same, the water vapour carrying away the heat. When all the water is driven off the liquid becomes quiescent, in spite of its temperature, rising from 212° to near 400°, then a smoky vapour comes off and the oil becomes darker; this vapour is not vapour of lard, but vapour of separated and recombined constituents of the lard, which is now suffering dissociation, the volatile products passing off while the non-volatile carbon (*i.e.*, lard-charcoal) remains behind, colouring the liquid. If the heating be continued, a residuum of this carbon, in the form of soft coke or charcoal, will be all that remains in the heated vessel.

We may now understand what happens when something humid—say a sole—is put into a frying-pan which contains fat heated above 212°. Water, when suddenly heated above its boiling point is a powerful explosive, and may be very dangerous, simply because it expands to 1,728 times its original bulk when converted into steam. Steam-engine boilers and the boilers of kitchen stoves sometimes explode simply by becoming red-hot while dry, and then receiving a little water which suddenly expands to steam.

The noise and spluttering that is started immediately the sole is immersed in the hot fat is due to the explosions of a multitude of small bubbles formed by the confinement of the suddenly expanding steam in the viscous fat from which it releases itself with a certain degree of violence. It is evident that to effect this amount of eruptive violence, the temperature must be considerably above the boiling-point of the exploding water. If it were only just at the boiling-point, the water would boil quietly.

As we all know, the flavour and appearance of a boiled sole or mackerel are decidedly different from those of a fried sole or mackerel, and it is easy to understand that the different results of these cooking processes are to some extent due to the difference of temperature to which the fish is subjected.

The surface of the fried fish, like that of the roasted or grilled meat, is "browned." What is the nature, the chemistry of this browning?

I have endeavoured to find some answer to this question, that I might quote with authority, but no technological or purely chemical work within my reach supplies such answer. Rumford refers to it as essential to roasting, and provides for it in the manner already described, but he goes no further into the philosophy of it than admitting its flavouring effect.

I must therefore struggle with the problem in my own way as I best can. Has the gentle reader ever attempted the manufacture of "hard-bake," or "toffy," or "butter-scotch," by mixing sugar with butter, fusing the mixture, and heating further until the well-known hard, brown confection is produced. I venture to call this fried sugar. If heated simply without the butter it may be called baked sugar. The scientific name for this baked sugar is *caramel.*

The chemical changes that take place in the browning of sugar have been more systematically studied than those which occur in the constituents of flesh when browned in the course of ordinary cookery. Believing them to be nearly analogous, I will state, as briefly as possible, the leading facts concerning the sugar.

Ordinary sugar is crystalline, *i.e.*, when it passes from the liquid to the solid state it assumes regular geometrical forms. If the solidification takes place undisturbed and slowly, the geometric crystals are large, as in sugar-candy; if the water is rapidly evaporated with agitation, the crystals are small, and the whole mass is a granular aggregation of crystals, such as we see in loaf sugar. If this crystalline sugar be heated to about 320° F. it fuses, and without any change of chemical composition undergoes some sort of internal physical alteration that makes it cohere in a different fashion. (The learned name for this is *allotropism*, and the substance is said to be *allotropic*, other conditioned; or *dimorphic*, two-shaped.) Instead of being crystalline the sugar now becomes vitreous, it solidifies as a transparent amber-coloured glass-like substance, the well-known barley sugar, which differs from crystalline sugar not only in this respect, but has a much lower melting-point; it liquefies between 190° and 212°, while loaf-sugar does not fuse below 320°. Left to itself, vitreous sugar returns gradually to its original condition, loses transparency, and breaks up into small crystals. In doing this, it gives out the heat which during its vitreous condition had been doing the work of breaking up its crystalline structure, and therefore was not manifested as temperature.

This return to the crystalline condition is retarded by adding vinegar or mucilaginous matter to the heated sugar, hence the confectioners' name of "barley sugar," which, in one of its old-fashioned forms, was prepared by boiling down ordinary sugar in a decoction of pearl barley.

The French cooks and confectioners carry on the heating of sugar through various stages bearing different technical names, one of the most remarkable of which is a splendid crimson variety, largely used in fancy sweetmeats, and containing no foreign colouring matter, as commonly supposed. Though nothing is added, something is taken away, and this is some of the chemically-combined water of the original sugar, in the parting with which not only a change of colour occurs, but also a modification of flavour, as anybody may prove by experiment.

When the temperature is gradually raised to 420°, the sugar loses two equivalents of water, and becomes *caramel* —a dark-brown substance, no longer sweet, but having a new flavour of its own. It further differs from sugar by being incapable of fermentation. Its analogies to the crust of bread and the "brown" of cooked animal food will be further discussed in my next.

According to Mr. Kolb, one of the secretaries of the German Imperial Telegraph Department, the 127,166 galvanic cells in use cost £12,350, of which £2,727, or about 22 per cent., were recovered by the sale of the battery residues, consisting of copper, zinc, and lead salts.

GEOLOGY AND AGRICULTURE.

By J. VINCENT ELSDEN, B.Sc. (Lond.), F.C.S.

IN a country like England, in which a day's journey is sufficient to traverse rocks of every geological age, even the most careless observer cannot fail to be struck by the diversity of appearance presented by the different strata over which he travels. The stiff soils of the eastern boulder-clays, the sheep-farming of the chalk downs, the pasture-land on the cold clays of the Midland Counties, the rich land on the Old Red Sandstone, and the barren aspect of the rugged Silurian rocks of Wales all point to the fact that each of the great geological systems is characterised by peculiar agricultural features. But, in England, much of the contrast between the various formations is lost owing to the great extent to which the underlying rocks are covered up by superficial accumulations, which entirely change the character of the soil.

In Belgium similar differences are to be observed between the desolate plateau formed by the Palæozoic rocks of the Condroz and Ardennes, the fertile Hesbayan loam of the central parts, the barren Campine sands, producing only heather and pines, and the rich alluvial soil of the Polders.

In Norway, the fjelds, or elevated plateaux, which occupy more than half its area, are perfectly barren; and, in Sweden, the cultivated tracts coincide with the deposits of glacial clay and marl, which cover up the gneiss and granite.

From the alluvial deposits forming the two immense plains of Hungary, one of the richest soils of Europe has been formed, and the chief source of the agricultural wealth of Russia is the recent deposit, known as the Tchornoi-zem, or black earth, which occupies the valleys of the Don, Dnieper, and Volga.

In America, the connection between geology and agriculture is still more marked. The sudden transition from the fertile alluvium of Virginia to the barren sands, clothed with pine forests, which characterise the Tertiary beds; the dry chalk downs and treeless prairies, famous for Georgian wheat, which mark the Secondary deposits, and the general husbandry and fertile soils of the Primary rocks, forming the lower parts of the Alleghanies, show the geological features of the country almost as perfectly as would a careful survey of the underlying rocks.

It is not to be supposed, however, that these differences in agricultural features are due to the character of the soil alone, for climate has as much influence as soil in modifying agricultural operations; but since climate is regulated mainly by contour, and contour depends chiefly upon geological structure, there is the same primary cause for variations in both cases. Nor must it be forgotten that it is the tendency of improved systems of agriculture to overcome all obstacles to the growth of crops, even in soils which are naturally unsuited to them; and thus the natural diversity of character which formerly existed is, to a great extent, destroyed. This is especially noticeable in the improvement of large tracts formerly regarded as wastes, and in the breaking-up of permanent pasture. For instance, the agricultural features of the chalk districts of England are by no means so marked, now that they have been invaded by the plough, as they were when in rolling downs and sheep pastures only. But in these cases the improvement is artificial, and the natural conditions would reappear if constant attention were not paid to the maintenance of the soil in an improved state. To the ordinary observer the appearance of a naturally fertile soil, and of a barren soil, rendered artificially productive, may be very much the same; but to the farmer the difference is extreme, for while the former is worked with ease, the latter can only be made to yield good results by endless trouble and expense.

Hence it is seen that not only do the natural agricultural capabilities of the soil vary with the geological structure of the rocks from which it is derived; but also that facilities for improvement and the amount of attention necessary to prevent deterioration are similarly influenced.

The natural vegetation of any locality is so entirely dependent upon the nature of the soil, that the geologist often receives great assistance, in mapping the boundary-lines between different strata, from careful observations of the plants which grow there. For instance, it is most interesting to note how that beautiful heath, *Erica Vagans*, which grows upon the serpentine of the Lizard district, in Cornwall, marks out the boundary of the barren serpentine from the fertile soils of the adjoining rocks. Buckland, writing in 1840, describes a moor in Dumfries, in which a band of bright green herbage marked the course of a trap dyke traversing slate rocks. Similarly, in Staffordshire the line of junction of carboniferous limestone and millstone grit is very clearly drawn on the surface by the sudden change in the quality of the grass, and four plants in particular mark the exact spot where soil changes—the furze, the heath, the whortleberry and the sorrel. In Hertfordshire, the boundary-line of the London clay is frequently defined by a verge of grass-land, which terminates with the out-crop of the chalk; while in the New Forest, the presence of the taller furze is a certain indication to the farmer that the land below is worth reclaiming. In many cases, also, particular formations are characterised by the trees which grow upon them. In Surrey, the Gault is distinguished by the luxuriant growth of oak and elm; while the Weald clay has long been noted for the perfection of its oaks. Beech trees abound on the chalk formation, and elms flourish on London clay, while the famous oaks of Bagot's Park, in Staffordshire, mark the position of an outlying patch of Lias. It is well-known that the districts most celebrated for their cider are situated on the cornstones and marls of the Old and New Red Sandstone formations, and, in Scotland, the Carse of Gowrie, so famous for its apples, stretches over the Old Red strata.

To such an extent, indeed, is vegetation influenced by soil and climate, that the experienced farmer can form an opinion as to the fertility of the land from the species of plant growing upon it. For this reason many parts of the British Isles have remained to this day untilled, forming the moorlands and heath-covered wastes so characteristic of many geological strata. But even a naturally fertile soil is frequently rendered unproductive by deficient water-supply or defective drainage. The scarcity of water in chalk districts is a source of continual trouble and expense to the farmer, who is obliged to sink deep wells, at a very great cost, or to depend upon the supply afforded by artificially constructed dew-ponds. In Alabama, the dryness of the chalk soils is a great hindrance to agriculture, for only farmers of large means can afford to undertake the deep boring necessary to obtain a supply of water. A similar scarcity of water is experienced on account of the extreme porosity of the Oolitic soils of the Cotteswolds. On the other hand, a farmer who is located upon impervious clays is put to no less an expense in getting rid of superfluous water by draining his land. Even upon porous rocks like the Old Red Sandstone, bogs are frequent on account of the sand becoming cemented into a hard mass, by means of oxide of iron, thus forming an impermeable pan.

(To be continued.)

LAWS OF BRIGHTNESS.

V.

By RICHARD A. PROCTOR.

THE law obtained at page 372 relates to smooth spheres, or spheres having a *mat* surface (German, matt, *dead*, as applied to surfaces), *unpolished*. It is useful to know the law, as it affords a means of determining how far the observed changes of brightness of those planets which present phases accord with the changes which would result if the surfaces of the planets were smooth.

To begin with the moon :—

Now here, before proceeding to consider the moon's total brightness at her phases, we find ourselves confronted by a circumstance which in no sense accords with what was shown in the preceding part of this paper, as to the brightness of a smooth sphere illuminated directly. We see that the disc of the full moon does *not* present that shading off towards the edge or limb which theory requires in the case of a smooth sphere. Setting aside the remarkable variety of brightness seen in different parts of the moon's disc, we find no perceptible tendency to diminution of brightness towards the moon's limb. If we look at the moon through a tinted glass suitably graduated, we find that the outline remains distinctly visible as long as any part of the moon (except, of course, the exceptionally bright spots) can be seen.

It is obvious that we must look for the explanation of this circumstance in the unevenness of the moon's surface. We can easily see, for instance, that if the moon's surface were covered *all over* with steep conical hills, something like the observed result would follow. For let *a*, *b*, *c*, Fig. 11, be steep conical hills on a globe, supposed to be illuminated from above ; the light rays meet the surface at

Fig. 11.

a small angle, and the illumination is therefore small ; hence, supposing these hills in the centre of the disc (that is, the globe "full"), they would appear as three dark spots, as a', b', c' ; and if the whole surface of the globe were covered with such hills the whole of the middle part of the disc would be dark, comparing its light with that from the middle of a smooth sphere of the same substance and under equal illumination. Such hills on the edge of the disc, as at *d*, *e*, *f* (and supposed to be illuminated in the same direction that the globe is viewed) would not appear uniformly bright, for at their edges they would be under very oblique illumination, while along a central streak the illumination would be nearly square (the hills being steep) ; but it is easily seen that the total illumination of a hill-covered region so placed might be (according to the slope of the hills) rather greater than, or very little less than, the illumination of the spots, a', b', c'.

It appears to me, however, that it is on the whole more satisfactory to regard the general unevenness of the moon's surface as due rather to crateriform elevations than to conical hills. (It must be noticed that we are not concerned here with the features revealed by the telescope ; since the nature of the illumination of different parts of the full moon must be mainly due to irregularities not discernible by the telescope.) Now, if we take a crater having such a section as is shown in Fig. 12, we see that under vertical illumination we should have the base C D fully illuminated, and the slopes B A, E F somewhat

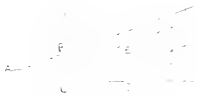


Fig. 12.

obliquely illuminated ; while under the oblique illumination from the right, indicated by the transverse lines, we have B C and E F (the only parts under illumination), both illuminated nearly squarely. Of course, the latter remarks only relate to one cross-section of the crater : but it is easily seen that the oblique illumination may give the same apparent illumination for the crater (regarded as a whole, and viewed in the same direction that the light falls) that direct illumination gives. If C D be of less reflective power than A B C and D E F, of course the oblique illumination would have a further advantage, the direction of the line of light being such that the dark bottom of the crater would be concealed behind the wall D E F.

I forbear from entering further, however, into such considerations as these, simply because the varieties and combinations of slope, position, tint, &c., are endless. It suffices here that the brightness of the moon's disc near the edge is explicable in a general way by the circumstance that the moon's surface is uneven.

It will be obvious that the total light received from the moon must necessarily be affected by a condition of her surface which renders the seeming illumination of different parts of her disc so different from that which would result were she smooth.* It is not easy to determine to what

* Some very strange assertions are made in a section of the "Encyc. Brit." devoted to the question of the moon's brightness. They illustrate what I have said respecting the errors commonly made on the subject of brightness, and I therefore quote the passage at length. The writer of the passage has given certain arguments (based on Bouguer's and Leslie's inexact estimates of the moon's total brightness) which appear to show that the moon is self-luminous. He proceeds as follows :—"Although these arguments go far to support the ancient opinion of the native light of the moon, they are not entirely conclusive, and indeed cannot be easily reconciled with some of the phenomena. If the moon shines in virtue of her native light, rays will be emitted in all directions from every point of her surface ; whence, since a visual angle of a given magnitude includes a much larger portion of a spherical surface near the extremities of its apparent disc than towards the centre, and as the number of rays is proportional to the surface from which they proceed, it follows that the intensity of the moon's light ought to be greater near the border than at the centre of her disc." (The writer was clearly unacquainted with the experimental law of the emission of light from self-luminous bodies). "The reason why this is not the case with regard to the sun" (he should have said, the reason why a variation of the opposite kind exists) "is that a greater proportion of the rays are absorbed in passing through a greater extent of the solar atmosphere : but the moon, having no atmosphere, ought to be sensibly most brilliant near the circumference of her orb. The contrary is, however, the case ; her light is greatest at the centre and less intense towards the circumference ('), exactly as it ought to be in

degree the total quantity of light would thus be affected. Zollner considers that the full moon shines nearly as brightly as though she were a flat disc under full solar illumination.

(*To be continued.*)

THE AMATEUR ELECTRICIAN.

BATTERIES.—II.

THE Bunsen cell is one which may be regarded as a "typical" cell, and accordingly it is proposed to deal with it in this article. It must not, however, be supposed that all has been said that we intended to say on the Daniell cell. There are certain modifications of it which only require to be more extensively known, in order for them to receive a much larger share of patronage. Our purpose in first dealing with typical cells is to afford, subsequently, ready means of comparison, as well as to save time and space, which would otherwise be occupied with repetitions which our present plan renders unnecessary.

The Bunsen cell consists of an earthenware jar, generally cylindrical, into which is placed a cylinder of zinc, made by rolling a piece of flat zinc into the required cylindrical form, but not allowing the two approaching edges to quite meet. The object sought is to facilitate the movement of the solution in which the metal is immersed. Within the cylinder is a round porous pot containing a rod of gas carbon. Brass terminals or binding screws are fitted on to the zinc and carbon, for purposes of connection. Concentrated nitric acid (specific gravity 1·420) is put into the porous pot or the division of the cell containing the carbon rod or plate. In the outer or zinc division is poured dilute sulphuric acid, or rather acidulated water. When the highest efficiency of the cell is required, the solution contains one of acid to seven of water, but this is a proportion not to be recommended, as it causes an extravagant waste of zinc by local action, of which more will be said below. A very fair proportion is one of acid to twelve or fifteen of water. Hydrochloric (or muriatic) acid (HCl) may be substituted for the sulphuric, but it is a little more expensive.

The action in the cell approaches, to some extent, the action in a Daniell cell. The zinc is dissolved and converted into sulphate of zinc (SO_4Zn), the hydrogen of the sulphuric acid (SO_4H_2) being set free. This, entering the porous pot, decomposes the nitric acid (NO_3H), forming water (OH_2) and nitric peroxide (N_2O_4). Expressed chemically, we get

$$Zn+SO_4H_2+2NO_3H=SO_4Zn+2OH_2+N_2O_4$$

Here it will be seen that when one volume of zinc is dissolved, two volumes of nitric acid are decomposed, and that for each double volume of nitric acid decomposed, a double volume of water is formed which dilutes the remaining acid, a volume of nitric peroxide being also produced. Thus the quantity of the nitric acid is being constantly reduced by the decomposing action, while that which remains is subjected to the weakening effect of water. At the same time the acid is further impaired by impregnation with nitric peroxide, which, also getting into the pores of the carbon, doubtless tends to produce a polarising effect by coating the particles of carbon. A large quantity of the nitric peroxide escapes into the air, and has a highly deleterious effect upon the human or any other animal system. It is apparent, therefore, that the Bunsen cell differs from the Daniell cell in one of the most important features. In the cell last mentioned, the strength of the cupric sulphate (SO_4Cu) solution remains constant, being maintained by a reservoir of bluestone crystals, but a similar reservoir of nitric acid is impossible. Even were it otherwise, the production of water produces a weakening effect, which can only be obviated by withdrawing both acid and water. The Bunsen cell is, therefore, inconstant, the strength of the current diminishing with the time. Presuming the porous pot to be well saturated, the diminution of the current theoretically commences the moment the circuit is completed, and in a few minutes it may make itself perceptible. A Bunsen cell, consequently, cannot be relied upon for more than three or at the outside four hours. At the end of that time, the nitric acid requires to be replaced by fresh acid; but the old acid may be used again twice or perhaps three times if it is allowed to stand aside for awhile to clarify it.

In the outer division the zinc is rapidly dissolved, and requires to be occasionally carefully amalgamated, otherwise, however good the zinc may be, local action—that is to say, action between two points on the zinc—will set in. Wherever the metal has two different structures or molecular arrangements, or has a chemically impure surface, there will local action be seen. One has only to place an unamalgamated zinc in a cell for an hour or so to see this. On taking the metal out it will be found to be eaten away very unevenly—sometimes in holes, sometimes in longitudinal striations.

Amalgamation is a process which homogenises the structure of the metal, and covers up all superficial impurities. The process may be carried out in a variety of ways. The metal surface is first cleaned by immersion in acidulated water. When the violent fizzing that accompanies the action of the water upon a bar or dirty piece of zinc has nearly subsided, the plate is coated with mercury. This is sometimes accomplished by placing the zinc in a solution of a mercury salt; but the readiest method is to coat the metal with the mercury either by rubbing it in with a piece of tow or cotton-wool, or by rolling the zinc in it. In the latter case the zinc should be allowed to stand a short time in a dish, &c., to drain off superfluous mercury. A pound of mercury is sufficient to roll a six-inch cylinder in, and will last a very long time. Zinc so treated infallibly works more economically than unamalgamated zinc, providing the entire surface of the metal is so treated. The reason assigned is, that the mercury associates itself with the zinc and presents to the solution a surface which is absolutely homogeneous, and which, therefore, does not favour local action. When the metal becomes dull, reamalgamation is necessary.

The cost of making a Bunsen cell is small. One of about a quart capacity is the most generally useful. The outer jar would cost a few pence, as would also the porous pot. The carbon rob, which may be about an inch square and seven inches, or thereabouts, in length, can generally be obtained at the rate of a penny an inch. The cost of the carbon is almost exclusively due to the hard nature of

the supposition of its being occasioned by the reflection of the solar light." I do not know the author of the passage. I may take this opportunity of noticing that in a passage of an article on the "Indications by Phenomena of Atmospheres to the Sun, Moon, and Planets," in the *Monthly Notices* of the Astronomical Society for 1862-3, page 237. Prof. Challis, while correctly stating the law for the case of a self-luminous body, falls into an error (which the above writer avoids) when speaking of opaque illuminated bodies. He says "a distant spherical body, whether self-luminous or shining by reflected light, would, according to the law that the intensity of the radiation varies as the sine of the angle which the direction of emanation makes with the surface, appear equally bright at all points of the disc." Those correspondents, therefore, who have addressed letters to me asking whether an opaque body under full illumination should not so appear, will see that their mistake is one easily fallen into.

the substance, which can, generally speaking, be obtained gratis from a gas company's works. It is one of the waste products in gas manufacture, and has no other marketable value. Anent the zinc, our remarks in the preceding article are applicable, but a little word may be added here. If the amateur has a small pocket, and is unable to get $\frac{1}{4}$-inch zinc bent, he may use $\frac{1}{8}$-inch, and by raising it to a fairly high temperature, he will find it capable of being easily bent. The retail price for a cylinder weighing a little over a pound is 1s. 9d., or about three times the price of the metal.

Amateurs often complain that the zincs get dirty, and covered with a white salt when put away after using them. They will experience no such trouble if they will remove the zinc from the solution when the battery is done with, and, after carefully and thoroughly rinsing it with water, wipe it dry with a piece of common calico, and then place it in a cupboard or other receptacle apart from the porous pot (which may be advantageously left in the acidulated water) and the carbon block.

The resistance of a Bunsen cell is practically nil, being less than the tenth of an ohm. The electro-motive force is, on the other hand, high, being 1·9 or 2·0 volts.

The cell is useful for laboratory or other experimental work, on account of the intense current yielded by it; but, on account of its rapid polarisation, it is useless where constancy is required.

The Grove cell is similar to the Bunsen, the difference being that the former contains a platinum foil in the place of carbon. Its efficiency is about the same as the Bunsen, but it is cleaner, and, being generally made in the flat form, takes up less room. Its cost is about 50 per cent. more than that of the Bunsen.

SAVAGE AND ANTHROPOLOGIST.

When the "Special Extra Meeting of the Anthropological Institute" was held at the Piccadilly Hall last week, the Botocudos must have been intensely amused. It must not be imagined that the interviewing in this matter is all on the side of the European. Mr. H. M. Stanley has recorded how, in his South African wanderings, he was persistently humiliated by the consciousness that while he thought he was discovering the savages, the savages would insist upon discovering him. When he visited one of their encampments, they surrounded him as an unusually tame specimen of a peculiar pale-coloured variety of human being. They took off his clothes to look at his skin, and noted with satisfaction that he would eat the ordinary viands of life. Thus it frequently happened that Stanley departed from one of their "towns" with the sorrowful knowledge that the anthropologically-minded Africans had picked up more information about him than he had about them. The same fate befell the Man among the Monkeys. They regarded him as a large and hitherto unknown species of monkey, which "resembled an onion" in so far that it had several skins which peeled off easily. In both these cases, however, the European was one among many, whereas at the Piccadilly Hall the odds are all the other way. Nevertheless, the four Botocudos there evidently consider themselves numerous enough to form a scientific quorum for the discussion between themselves of any more than usually peculiar anthropological curiosity in a tall hat that may chance to enter the hall, with the idea that he is the sightseer and the Botocudo the sight—and not a very inspiriting one at that. But when the special extra meeting of the Anthropological Institute appeared on the scene, the Botocudos must have been really thankful for the treat provided them. When some Fijian savages, under the guidance of a missionary, for the first time visited an English man-of-war, they could hardly express their gratitude sufficiently. "We beheld the men in great numbers, and very industrious at their work," they said, and "we respected them greatly. We beheld the chiefs of the ship, and reverenced them greatly. We young men of this generation were born in blessed times to see such a ship as this. Our fathers saw no such sight." So doubtless the anthropologists and the Botocudos last week equally congratulated themselves upon their good luck. Never before had the anthropologists seen four Botocudos together, one of them with a large piece of wood stuck in her lip; and never before had four Botocudos seen so uniformly venerable an assortment of white men, the majority with oval pieces of glass fixed by wires in front of their eyes, and some of them quite bald. Their fathers saw no such sight.

Nor is it quite certain that in a cursory comparison the Botocudos would not be able to credit themselves with the superiority. It is true that the old lady of their party has distended her lower lip to the size of a tobacco-pouch, but she has not pinched in her waist to a 6½-inch diameter, nor does her husband wear a shiny black funnel, with a brim to it, upon his head. The daughter, too, has obviously no need of stays; and the son's splay feet have been allowed to tread in Nature's free and easy lines; so that between the swarthy youth inside Piccadilly Hall and the gilded youths upon Piccadilly pavement outside, if an active cockroach were the umpire, there can be little doubt which would be pronounced the most effective "masher." The manners and customs of the white men, too, are worth noticing. When two of them meet a third, one of the two steps forward, says a few words to each of the others, and then they take off their tall hats and wave them gently towards each other's feet; and then they put them on again. After that they catch hold of each other's hands and shake them strongly, grinning all the time as if they were happy. Among the transactions of the Anthropological Institute of Botocudoland it will, no doubt, be recorded that the English are in many ways—according to the report of the Botocudo deputation that explored London in 1883—a peculiar race of men, and that the variety known as "anthropologists" are especially remarkable for their age, their fondness for palavers, and their inquisitiveness.—*Globe.*

Some kinds of white glass become, in the process of time, more or less deeply coloured under the influence of luminous rays. The most common tints are violet and green. The materials of ordinary glass are somewhat ferruginous and capable of tinging glass with a deep green shade by the protoxide of iron. In order to remove the colouring, peroxide of manganese is added, which changes the protoxide into a sesqui-oxide, which gives a feeble reddish-yellow tint. It is almost impossible to observe the proper proportions of manganese and iron. If there is too much oxide of manganese the glass has at first a violet shade; if there is too much protoxide of iron the glass will be greenish; if all the manganese is reduced to a state of protoxide the glass is colourless. The influence of light and air may gradually bring about a partial oxidation of the protoxide of manganese and a violet colouring which increases with time. The *Chronique Industrielle* says a shade which is due to an excess of manganese is observed in the Pinacothek, at Munich, where the upper windows of the picture-gallery give a very marked violet light which produces a bad effect.

THE FISHERIES EXHIBITION.

NATURAL HISTORY DEPARTMENTS.

By John Ernest Ady.

II. (*continued*).

We now pass on to consider the relation of the minute organisms considered in our last article, to the important formations which have and are still taking place in the bed of the deep sea, and on which so much light has recently been thrown by the late Sir Wyville Thomson, and his associates of the *Challenger* expedition. If a piece of chalk, such as that of Gravesend, be gently powdered in a mortar, the mass tied up in a small bag of coarse calico, and kneaded thoroughly in a large bowl of fresh water until it has been reduced to about one-fourth of its bulk, a milky fluid with an appreciable deposit will result; the supernatant liquor may be poured off, and the residue thoroughly well washed in a large test-tube, and allowed to settle. This operation should be repeated several times, after which it will be found that the deposit consists almost entirely of the tests of *Foraminifera* mixed with a variety of things, such as sponge and other spicules, &c. Conspicuous amongst the *Foraminifera* two beautiful forms may be recognised; these are *Globigerina* and *Textularia*.

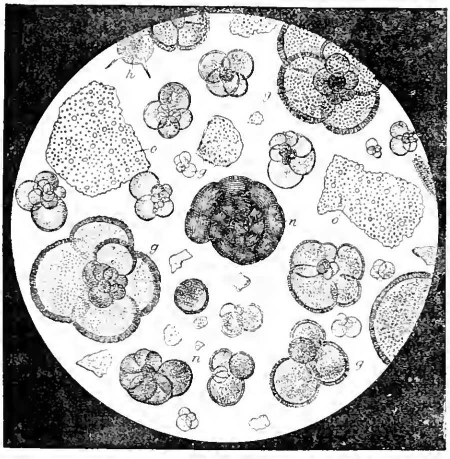


Fig. 3.—Globigerina Ooze, floor of the Atlantic Ocean, × 65. *g. Globigerina bulloides*; *o.* Fragments of *Orbulina universa*; *n.* Nautiloid Foraminifera; *h. Haliomma*, one of the *Polycystina* (*Original*).

As long ago as 1865-1866 Major Owen read two papers to the Linnæan Society, descriptive of the life-habits of *Globigerina* and other forms, which he obtained from the surface-waters of the Indian and Atlantic Oceans by the use of a tow-net. Later on, Gwyn Jeffreys* asserted that these were exclusively oceanic, and confined to the upper stratum of the sea, in opposition to the opinions of his associates, Wyville Thomson and Carpenter, that they were abyssal. During the voyage of the *Challenger* Murray had ample opportunities for proving the correctness of Jeffreys' statement, and showed beyond doubt that these creatures are indeed pelagic, and that only after death do their bodies subside to the bottom, where they form the basis of a whitish deposit termed "Globigerina ooze" (Fig. 3), so called from the preponderance therein of the tests of *Globigerina*.

We shall have occasion in future to point out that other forms than *Foraminifera* (*e.g.*, *Radiolaria*) live, die, and are in like manner deposited. Fig. 4 shows two Radiolarians drawn from living specimens.

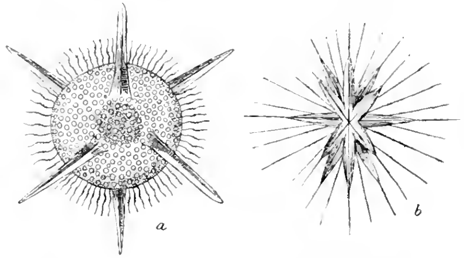


Fig. 4.—Radiolaria; *a. Haliomma he acanthum*, one of the *Polycystina*, with radiating pseudopodia; *b. Acanthometra lanceoatal.* (After J. Müller, Abhandl. d. K. Akad., Berlin, 1858).

The shells of the fresh *Globigerina* are pellucid, and of a firm consistency; they are perforated by many pores, surrounded externally by a kind of crest, so that the pore commences at the bottom of an hexagonal pit; at each angle of this crest a delicate, long calcareous spine is given off, and these radiate from the centres of the respective chambers of the shell to which they belong. The whole system of spines produces a marvellously beautiful effect, and has been accurately figured and described by Wyville Thomson;* he has stated that pseudopodia have not been discovered in these animals.

After the tests sink to the bottom to produce the so-called ooze, they become opaque, lose their spines, and finally disintegrate.

In Fig. 3, which represents a sample of Globigernia ooze from the floor of the Atlantic, fragments of another organism may be observed. These are portions of the tests of *Orbulina universa*, and may be readily distinguished from those of *Globigerina* by their pores, which are of two sizes, one about four times as large as the other. *Orbulina* is spherical in shape, and sometimes contains a series of internal chambers, which resemble a small *Globigerina*. This led Max Schultze and others to suppose that it is but a reproductive phase of *Globigerina*.

It has been shown by the *Challenger* results that *Globigerina* exist in vast numbers all over the surface of the ocean, and are especially abundant in the warmer seas; accordingly, it would be but natural to suppose that the deposit on the sea-bed should always contain their tests; but this is by no means the case, and was at first an enigma to the naturalists of the *Challenger*, who came to a solution of the difficulty through the following observations:—They found that with increasing depth the nature of the deposit varied—so much so that they were able to predict what it would be at a given depth. At about 2,250 fathoms the Globigerina ooze gradually changes into a "grey ooze," which is characteristic of 2,400 fathoms. Deeper down (2,700 fathoms), the deposit is known as "red clay." From chemical experiments superadded to observed facts, they were led to discover that the calcareous Globigerina ooze is so acted upon by the solvent action of the sea water, that it is gradually broken down into the grey ooze, and

* Proc. Roy. Soc. London, Nov. 121, p. 443.

* Proc. Roy. Soc. London, 1874, No. 156, p. 35, Plate I.

thereafter into the red clay, which proved on analysis to consist of a silicate of the red oxide of iron and alumina, and which now contains but few testaceous remains (siliceous shells of *Radiolaria*, sponge spicules, &c.)

Sir Wyville Thomson noted the capture of numerous highly organised *Invertebrata* in this red clay, such as large *Holothuria* with only rudimentary calcareous neck-rings, and a paucity of or no spicules in their tegumentary system; also of delicate *Polyzoa* with their zooœcia almost wholly membranous, and the tubes of a tube-building annelid (*Myriochele*) still living; and he reflects on the possibility of such a formation in palæozoic times, the vestiges of which are to be found in the Cambrian *Oldhamia*, in siliceous sponges, and peculiar thin-shelled shrimps.*

The Globigerina ooze is usually bound together by a very fine comminuted paste, which at first sight seems to be amorphous, but under a high power of the microscope is resolved into a variety of rounded and excessively beautiful forms, two of which are here given in Fig. 5.

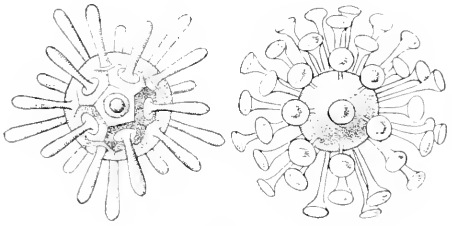


Fig. 5.—Rhabdoliths from *Globigerina ooze*. (After Sir Wyville Thomson, Proc. Roy. Soc., Vol. xxiii., Pl. 3.)

They have been termed "rhabdoliths," and are of the nature of similar rounded bodies called "coccoliths" by Huxley, and supposed to be *Algæ* of a peculiar form.

In conclusion, the formations which are now going on at the bottom of the ocean, and which are chiefly composed of these minute animal remains, point conclusively to the manner in which extensive formations, such as the chalk, Nummulitic limestones, &c., were evolved, and to the importance of the living things, which, although they are so diminutive apart, and not of any great commercial value directly, are intensely interesting to the philosophical observer.

* Loco citato, p. 47.

THOUGHT-READING.

"NONSENSE dies hard," says Mr. Labouchere, and he is perfectly right; but no nonsense dies harder than the nonsense of infatuated prejudice. Amongst literary men, those who know Mr. Henry Sidgwick and Mr. Labouchere—the two who wrote to the *Times* on the Thought-reading wager—very few, we suspect, would prefer Mr. Labouchere's judgment on a matter of evidence of this kind to Mr. Sidgwick's. Mr. Sidgwick has as cool and sceptical a temperament as Mr. Labouchere himself, but he has in addition a very much larger knowledge of the subject under investigation, and knows how absolutely childish it is to speak of such a power as some persons impute to Mr. Bishop as a miraculous and all but incredible thing. We say this without having formed any definite opinion ourselves on the subject of Mr. Bishop's powers, and, indeed, with a strong prejudice against a man who mixes up common conjurer's tricks with the professed attempt to illustrate obscure psychological powers of this nature.

But this we will say, that to all who have studied the subject, evidence literally *abounds* of the existence in rare cases of powers of thought-reading much more remarkable than any alleged in the case of Mr. Bishop. As we do not like to make this sort of statement without any kind of verification, we will take a modern instance from the writings of a Bristol medical man, Dr. Davey, who published a paper in the *Journal of Psychological Medicine* for April, 1881 (Part 1 of Volume VII. of the *Journal*), which records the case of a patient of his, investigated by him in concert with two other Bristol medical men—Dr. Andrews and Dr. Elliott. Here is Dr. Davey's description of Mrs. Croad's state :—

In 1870, it is stated, "she became totally blind;" in the following year deaf, and in 1874 speechless. The paralysis, which was limited to the lower extremities, involved, in 1879, the upper limbs; but at this time the loss of sensation and motion is limited to the left arm, the fingers and thumb of the left hand being but partially affected. The right hand and arm have recovered their once-lost functions. She is now able to articulate, though with difficulty, from, as it appears to me, a tetanic rigidity of the temporal and masseter muscles, by which the mouth is kept, to a large extent, fixed and closed. It was in October last [*i.e.*, October, 1880] that I was asked to see Mrs. Croad. I found her sitting on a semi-recumbent position on a small bedstead, her head and shoulders resting on pillows. The eyelids were fast closed, and the left arm and hand resting by the side. The knees I found then, as they are still, bent at an acute angle, the heels closely pressed to the under and upper parts of the thighs. . . . . Since October, and through the months of November and December, 1880, I have subjected Mrs. Croad to many and various tests with the view of satisfying myself as to the truth or otherwise of the statements given to the world of her blindness, sense of touch, and marvellous sympathies. To my near neighbours—Drs. Andrews and Elliot—I am much indebted. The various tests referred to were witnessed by them in my presence, and with the effect of assuring us that she (Mrs. Croad) was and is enabled to perceive, through the aid only of a touch, the various objects, both large and small, on any given card or photograph. After an experience extending over some nine or ten weeks, during which the "tests" were many times repeated, and, now and then, in the presence of several medical and non-medical (ladies and gentlemen) friends, there remained (I believe) not the least doubt of this "transference of sense" from the eyes of Mrs. Croad to her fingers and the palm of her right hand. It need not to be supposed that I and others were content to believe in Mrs. Croad's blindness, and to take no specific precautions against any possible trick or deception—far from this. On solicitation, she very kindly assented to be blindfolded, after a very decided fashion; and so blindfolded, that neither deception on her part nor prejudice nor false judgment on ours were—either the one or the other—possible. The blindfolding was accomplished thus: a pad of cotton wool being placed on each orbit; the face was then covered by a large and thickly-folded neckerchief; this was tied securely at the back part of the head, and—even more than this—more cotton wool was pushed up towards the eyes, on either side of the nose. Not content, however, the aid of two fingers of a bystander were called into requisition, and with these a continued pressure was kept up, during the 'testing,' outside and over the neckerchief and wool, and above the closed eyes. At this stage of the proceedings the room was, on two different occasions, very thoroughly darkened. Under such circumstances it was the testing commenced, and continued to the end; the result being, as theretofore, in the highest degree, conclusive and satisfactory. The transference of sense from one organ to another as an acquired and spontaneous condition of being must, on the evidence here adduced, be accepted as a demonstrated and certain fact. I would state here, that on receiving a picture card or a photo' from a bystander she (Mrs. Croad) places it on and about the chin or mouth, and perhaps draws it across the forehead, but the minute examination of the card is, apparently, the work of the fingers of the right hand. These several acts are, for the most part, followed by a quiet and intense thought, a well-marked concentration of mind on the picture, or whatever it may be, when, after a short time, she writes on a slate kept near her a description—sometimes a full and detailed one—of the card, its colouring, and the several objects thereon. I have seen some forty or fifty picture-cards and photographs described by Mrs. Croad at different times with various

degrees of accuracy during the whole period I have known her. Occasionally her rapid and precise perception, or, if you prefer the word, conception, of the picture, and of the many, yet minute and trifling, objects going to form its entirety, is really startling. I have but seldom seen her wholly at fault, though she has met with her failures.

Now, this seems to us a much more marvellous power than that of thought-reading; but this is not all. Mrs. Croad appears to have had the very power which Mr. Bishop attributes to himself, in a very much higher degree :—

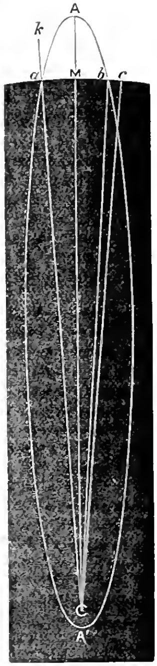
Sitting quietly by, or near to, Mrs. Croad, my attention has been again and again rivetted on the manner in which Miss Croad holds communion with her mother. Miss Croad does very certainly move her fingers over and about the face of her mother, but few, if any letters or words are formed by her. Watching her very narrowly, on several occasions, I felt at length assured that Miss Croad's communications were altogether unlike those made by either visitors or friends. The latter named formed letters, and with these words, and so conversed—if the expression be allowed—with Mrs. Croad; but it is not so with her daughter. Impressed with the fact as above stated, I spoke to Miss Croad of it, when she told me that as the rule it was requisite simply that she put herself in a close or personal contact with her mother to convey to her what was wished, or to give her a knowledge of this or that, as the case may be. Now, so marked a mental sympathy or concordance as this is altogether without or outside the experience of most of us; and it is therefore well worthy the attention of those present who have the courage to investigate, what I may well call, unorthodox medicine. . . . . As a further illustration of Mrs. Croad's peculiar and clairvoyant gifts, it should be stated that at my second interview with Mrs. Croad, and in the presence of Dr. Andrews and others, certain of my own personal and private convictions on a particular subject became, as it would seem, in a strange and exceptional manner, known to Mrs. Croad. She asked me if I would allow her to tell me a secret in my own life-history, and would I be offended if she wrote it on her slate. I replied, "No." That written on the slate was and is a fact, than which nothing could or can be more truthful and to the point. Dr. Andrews is prepared to verify this; the others present on this occasion were but little known to me.

Here we have one of the most remarkable amongst numbers of instances of thought-reading, known to all students of the more abnormal facts of psychology—an instance encountered by steady-going professional men, in the ordinary course of their profession, and never produced on platforms for the amusement of the crowd at all. Dr. Carpenter, in his remarkable work on "Mental Physiology," has admitted the probability of the existence of some such power as this, on the evidence in his own possession; indeed, Mr. Bishop declares that Dr. Carpenter has verified the real existence of some kind and degree of this power in Mr. Bishop himself, and has stated his belief that Mr. Bishop's powers have been tested under strictly scientific conditions. Now, we do not pretend to have any specific opinion of our own upon Mr. Bishop's case, and have absolutely no right to any such opinion. Nothing is more marvellous than the assumption of a mere man of the world like Mr. Labouchere, that because the phenomena have never come within his knowledge, they are incredible. To him, apparently, opinions like Dr. Carpenter's are not even entitled to a respectful recognition, for he does not refer to them, unless it be in the remark that "nonsense dies hard." At all events incredulity dies hard. There are plenty of facts on which eminent medical men have come without having any motive whatever for credulity, and to which they have been compelled to give their attestation, such, for instance, as those we have quoted from Dr. Davey's address to the Bath and Bristol Branch of the Medical Association, far more remarkable, and far more difficult to bring under any of the known laws of nature, than the achievements of Mr. Bishop, even if these achievements be what Colonel Statham and Colonel Trench affirm, and what Mr. Labouchere denies.—*Spectator*

FLIGHT OF A VERTICAL MISSILE.

BY RICHARD A. PROCTOR.

Let a b c *be part of the earth's equator,* C *the earth's centre, and let a missile be projected in direction* a k *(vertical), with a velocity of* 1,000 *ft. per second. Supposing the point* a *to be carried to* c *during the flight of the missile, determine the point,* b, *where the missile will reach the ground—in other words, determine* b c *the westerly deviation of the missile. (The resistance of the air is neglected.)*



Let aAb be the actual path of the missile, and part of a long ellipse AA′ about C as farther focus, the portion aAb being appreciably parabolic. Join Ca, Cb, Cc, and draw AM to bisection of arc ab. Then, by Kepler's second law, the missile in moving around the path aAb, sweeps out equal areas around C; and obviously the point a sweeps out equal areas around C, as it is carried uniformly along the arc abc. Moreover, it is clear that the missile as it starts from a and the point a in passing from its initial position a are sweeping out the same equal areas around C (for the increase in the missile's distance from C does not affect the momentary description of areas, which depends only on the rate of motion perpendicular to the radius vector). This equality continues throughout the motion, since neither the missile nor the point a changes its rate of describing areas around C. Consequently, when the missile reaches b, at which time the point a has come to c, the total areas described are equal, that is, area $aCbA$ = sector aCc, or, removing common sector aCb

area aAb = sector bCc,

that is, since aAb is appreciably a parabola and aMb a straight line perpendicular to the axis AM,

$$\frac{2}{3} ab \, . \, AM = \frac{1}{2} bc \, . \, abC.$$

$$\therefore \frac{bc}{ab} = \frac{4AM}{3bC}; \text{ or, putting } AM = h, \, bC = r,$$

$$\text{westerly deviation} = bc = \frac{4}{3} \frac{h}{r} . ab.$$

Compared with ab, bc is so small that we may put ac for ab without appreciably affecting the result; and obviously, if $2t$ is the time of flight (t for the ascent or descent), P the earth's rotation period, we have

$$ac = \frac{2t}{P} . 2\pi r$$

$$\text{wherefore } bc = \frac{2t}{P} . 2\pi \left(\frac{4h}{3}\right) = \frac{16\pi ht}{3P}$$

Cor.—If the place of projection is in latitude λ, the westerly deviation is

$$\frac{16\pi ht \cos \lambda}{3P}.$$

Note.—I said incorrectly that Mr. Bray's result at p. 393, letter 853, was correct. It is only half the actual

deviation. For, if we substitute in the above formula his correctly stated values for t and h, we get westerly deviation for a missile projected vertically with a velocity of 1,000 ft. per second

$$=\frac{16\times3000000\times6000\times\pi}{3\times193\times193\times24\times60\times60}$$

$$=\frac{1000000\pi}{(193)^2\times9}=93{\cdot}62 \text{ ft. (about).}$$

It may interest inquirers into problems of this sort to find out why Mr. Bray's apparently correct reasoning leads to a result twice as great as it should be. If I can find time and space, I will give, shortly, in the mathematical column, an analytical solution of the problem.

GOD'S WILL.*

SPEAKING of the Sunderland accident, the *Spectator* makes the following pregnant remarks :—

"The moment the calamity was known, every one seems have behaved admirably, and the tone of the town since has been the true one, that of sad but helpful resignation to an inexplicable Will. For it is an inexplicable Will, especially to those who believe, as we do, that God governs, as well as reigns. What should we say of a man who, merely by putting a thought into Mr. Fay's head, the thought to stand at the gallery-door and see the children out in batches, could have prevented that ghastly massacre, and did not put it? Yet that must be true of the Almighty, if any one of our ideas about his attributes is true, if he foresees, if he is all-powerful, if he has free-will. Apart from the suffering—suffering often to the good, for it was probably the kindest parents who sent their children to the show—why does he allow all that monstrous waste of life among the innocent, that destruction of potential usefulness? The only answer is the simple and unsatisfying one that we know nothing about the matter, and never shall know all, though we may know much more than we do now. Man cannot know the policy of God, which is not shown as changed, but as always the same, in these great catastrophes. They do but concentrate a process which never stops. Taking Asia and Europe together, the half of all children born die before they are two. It is certain that more children died in London in the week of the catastrophe, unnoticed, than died in Sunderland to the horror and pity of the world. It is quite probable, though there are no statistics, that more children died in the United Kingdom still-born on Saturday than died in that staircase shambles. Vast, unending, inexplicable waste of life, never utilised even for a little while, is the law of the planet, the will of its Creator, as little to be made intelligible by thought as the endless mystery of non-educative pain. Theology gives us no more light on the subject than Science does, and though it is best, or at least most comforting, to think that the children are the happier for escaping this life and its miseries, there is no proof of that—rather evidence from analogy that they lose an opportunity which would have been to their profit. Why not, if the world, and life in the world, are, as we all suppose, of any use at all? Men are not the better for escaping, but for fulfilling, duties. There is no explanation whatever to be found, nor is there any need of one. If man acknowledges God at all, he must acknowledge a Being whose wisdom must be so far above his own that failure to perceive it is failure in the creature, not in the Creator. It may not be an absurdity, though it seems one to us, to recognise God, and yet think that he can err; but it is certainly a folly to think that we can detect error in Him. The theologian, like every other man, is studying the Infinite, and when he has thought himself out, he can only acknowledge that he is always at last face to face with a mystery past his solution. Thought sometimes only helps us to pile up more figures on the recurrent decimal.

* From the *Spectator*.

Editorial Gossip.

ONE cannot but be amused at the tone of jeering superiority with which the psychical problems involved in such questions as thought-reading and thought-finding are dismissed by folk who are only not stupidly credulous because they are stupidly incredulous. With such persons there is no middle path; they either refuse to consider evidence at all, or they swallow everything they are told. In either case it is the same defect in the unscientific mind which does the mischief. A man of this class believes or disbelieves—he does not inquire. Take such a subject as mesmerism, for example:—"Mesmerism! my good sir," he will say; "mesmerism is utter humbug; nothing in it but lies and trickery;" or, it may be (just according to the way in which he has taken up the matter), he will talk equal nonsense on the other side, and tell you that mesmerism is the most marvellous power in existence.

MANY years have passed since I made my first acquaintance with these two classes of persons—or rather with these two forms of the same class. A man named Zamoiski came to Cambridge, who professed to possess marvellous mesmeric powers. He really had a very fair amount of that particular mind-influencing power which we may conveniently call mesmerism (as a name not suggesting any theory as to the nature of the power). But he promised all manner of performances, far outside of anything he or any man could do without the aid of confederates. He appeared on the platform, went through a number of performances, some interesting and curious, but by no means miraculous, on college men of various standing, others which would have been marvellous indeed if they had been genuine. But they were performed on certain boys who were no doubt paid for their parts in the display.

I FOUND after the performance that those who had seen it could be divided into three classes, two nearly equal in numbers and one much less than the others. There were a number who supposed the whole series to be humbug, the collegians being in the trick like the rest; a number more accepted the whole series as genuine because they *knew* that the collegians were not in it. The few, more scientifically minded, recognised the evidence for what it was worth. A certain phenomenon, partly mental, partly physical, had been observed, strange enough to explain why weak-minded persons supposed there was something uncanny in it, but not at all outside what is natural. This phenomenon, though rejected by the weak-minded of another sort as sheer trickery, seemed yet well worth inquiring into in a scientific way,—that is, under the test of observation and experiment.

I SUPPOSE I had begun, even at that time, to have scientific tastes—though my friends and the worthy Fellows who had dealings with me failed to recognise this characteristic. Any how, I determined to test Zamoiski's powers by enabling him to give a less public entertainment. My largest sitting-room (I occupied rooms intended for a Fellow) could accommodate more than forty. So I and a

few friends invited the mesmerist to try his powers on as many as could be brought together, at a day's notice, in my room. There came, in all, forty-two, including seven or eight "dons" (among them the Rev. S. Parkinson, my private tutor), about a score of Wranglers, and ten or twelve first-class Classics—"in sooth a goodly company." Zamoiski came along in due time, with a galvanic apparatus to keep him lively. He wanted to go through his customary discourse; but "we would none of it." We wanted simply to test his power of influencing mind and muscle. He tried nearly all of us (all, in fact, who were not unwilling). Among the number was my friend, W. Baily (Second Wrangler that year), who had been influenced to some degree—slight, but enough to show the reality of the phenomenon at the public exhibition—and Mr. Garrett, our organist (collegian also), who had felt the influence of Dove and other mesmerists. Zamoiski failed all round at the first trial. On this Mr. Garrett said: "You ought to succeed with me; for Dove did," or words to that effect. Zamoiski then gave his whole energies to influencing him, and at last with such success as to make Mr. Garrett forget (or rather become for a few moments unable to recall) his own name. After this he tried others with whom he had before failed, but in whom he had recognised signs of yielding to the mesmeric influence (whatever it may be). He achieved a fair measure of success. My friend Baily was so far influenced as to be unable to open his eyes except with an effort. Others were unable to strike the mesmerist's hand, though they went willingly—even rather viciously—for it. (This had happened in the public exhibition with well-known University men, some of whom, as Ingham of the 'Varsity boat, would have made M. Zamoiski remember the evening, if they had got in at his rather soft-looking hand with their clenched fists, as they tried hard to do.) One or two had to struggle to remember their names, but succeeded after a few seconds. As I had expected, nothing very wonderful was done, but every experiment was satisfactory, as the whole company were known to each other, and all anxious to put Zamoiski to the test. Several who were not actually influenced said they felt they had to exert an active resisting power. I was not one of these. He tried his power on me in public and in my rooms, and I noticed only that a sort of resistance was excited which was barely noticeable, so easy it seemed to overcome the influence he was trying to exert. Even this I only noticed when, of set purpose, I sought to yield my mind to any influence which might be exerted upon it by him.

A FEW days later my fencing-master, Jackson, a sixteen-stone man, of splendid muscular development and full of vitality, told me that, while showing what Zamoiski had done and tried to do, he had found that he himself possessed the same power, and in rather greater degree. Zamoiski was a fat man, but not muscular. He seemed to be full of coarse vitality; but his lecturing (save the mark!) did not suggest the idea of superabundant mental power.

THE phenomena which the Pyschical Society are endeavouring to investigate are akin to those called mesmeric in several respects. There is nothing supernatural about them, though much that is mysterious, in the same sense that (for example) gravity is mysterious (but in infinitely less degree). Of course, to unscientific minds they necessarily appear either miraculous on the one hand, or imaginable on the other. Fortunately, it is not from either class of mind that science expects any developments in the way of progress. The most brilliant idea which has yet occurred to *such* minds has been that of proffering a wager!

OF Mr. Bishop personally, I may say, *vidi tantum*. Like his fellow-countryman, the late Dr. Beard (a thoroughly scientific inquirer, almost equally abused by the would-be keen ones), he appeared to me a man of an intensely nervous temperament. I know, from the report of trusted friends, that his powers of thought-reading and feeling-reading are very great; and in the range of such powers in what he claims to do and to have done there is certainly nothing beyond the natural. That he should obtain money through the exercise of his gifts does not seem to me open to exception, any more than that Bishops of another sort should receive money for exercising spiritual gifts—a point about which a certain Jewish writer has made very sensible remarks. It is unfortunate, perhaps, that so few take interest in purely scientific research that Mr. Bishop has had (I suppose) no choice but to relieve his mind-experiments with conjuring tricks; but in this there is nothing more objectionable than there is in the lecturer on astronomy relieving the strained attention of his hearers by an occasional anecdote or jest. The cool assumption that, because the power claimed by Mr. Bishop is beyond *their* slow minds, dullards are free to treat him as if he were a proved swindler, would be discreditable to them in the extreme, if it were not that—presumably—they know no better.

A CHEAP AND GOOD TELESCOPE.—We have received from Mr. Theobald one of his singularly cheap telescopes, which we have had excellent opportunities of testing during the last few weeks at the seaside. It is an excellent instrument—a perfect marvel for the price. It comes sharply and cleanly into focus, has a uniform field, and gives clear and good definition. We have not yet tried it on many double stars, not having a suitable stand. But it has done well with those we have tried. This little telescope will be found to give very pleasing miniatures of the lunar views described by F.R.A.S., though, of course, the young observer must not expect it to show such details as a 3-inch telescope presents. We hope soon to test the work of this capital little telescope on Jupiter and Saturn, and will report the results in due course.

POWDER MAGAZINE FIRED BY LIGHTNING.—A telegram from Scutari, Albania, dated 8th ult., says:—"The powder magazine of the fortress of Scutari was struck to-day by lightning. A great explosion followed, and a portion of the bazaar was destroyed. Many persons are reported killed." Later information says that ten soldiers and seven civilians were killed, and forty soldiers and fifteen civilians injured.

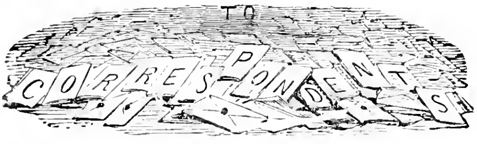
THE FORTH BRIDGE.—On Thursday, the 14th inst., Sir Thomas Tancred, one of the contractors for the Forth Bridge, laid, with Masonic honours, the first granite block of stone in connection with the structure. He was accompanied by Mr. Symons, one of the Government Inspectors, Mr. Gray, manager of the works at North Queensferry, and several other gentlemen. The stone, of pure Aberdeen granite, weighing about 16 cwt., was placed at the south-west corner of pier No. 12 from the south end of the bridge, which is situated a little to the east of the church at North Queensferry. There are now at the works—north and south—nearly 100 tons of Aberdeen granite for the outer casing of the piers. Four steam stone-crushers, each capable of crushing 80 to 90 tons per day, are at work preparing the whinstone for centring of the piers, and all along the line the greatest activity prevails in getting ready the preparatory operations required for this great structure.

THE FACE OF THE SKY.

FROM JULY 6 TO JULY 20.

BY F.R.A.S.

THE sun will be watched, as usual, for groups of spots and faculæ, which have recently become both more numerous and interesting. The face of the night sky will be found depicted on Map VII. of "The Stars in their Seasons," but there is no real night in the United Kingdom until July 22. The heavens continue to offer a practical blank to the observer, as far as the apparition of any of the planets is concerned. The moon is 1·9 day old at noon to-day (July 6), and quite obviously 15·9 days old at the same hour on the 20th; hence she is favourably placed for the observer during the greater part of the period of which we are treating. Her south declination, however, becomes considerable during the latter half of it. Two occultations of stars occur during the next fourteen days. The first is that of the sixth magnitude star 28 Libræ, which will disappear at the moon's dark limb at 11 h. 11 m. p.m. on July 14, at an angle of 119° from her vertex; but she will have set ere it reappears. The second occultation occurs on July 17, and is of B. A. C. 6,081 (also a star of the sixth magnitude). This will disappear at the dark limb of the moon at 11 h. 31 m. p.m., at an angle of 133° from her vertex; and reappear at her bright limb at 12 h. 41 m. p.m. at a vertical angle of 277°. During the next twenty-four hours the moon travels from Cancer into Leo. There she remains on the 7th, passing into Sextans during the early morning of the 8th. She leaves Sextans and travels into Leo again about 3 a.m. on the 9th. She remains in Leo until about 6 a.m. on the 10th, when she moves into Virgo. She does not leave this constellation until about four o'clock in the afternoon of the 13th, when she crosses into Libra. There she continues until about 6 p.m. on the 15th. In the course of the next ten hours she travels across the northern part of Scorpio into the southern portion of Ophiuchus, where she continues until six o'clock in the evening of the 17th, when she enters Sagittarius. She remains in Sagittarius until 8 a.m. on the 19th, and by noon on the 20th has travelled into Aquarius, where we leave her.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

RATIONAL DRESS.

[861]—The female members of my family complain that "Pedestrienne" fails to describe the only part of her dress which they want to know how to make, viz., the "divided skirt." They would like to try the costume recommended, but ask for a detailed description of what "Pedestrienne" means by a "divided skirt."

CYCLIST.

GENEALOGICAL PUZZLE.

[865]—The following may amuse some of your younger readers:—A and B are two persons in no way related—of no consanguinity. They meet, and one asks the other:—"How is our brother Tom?" [Tom being brother to both of them.] Show how this may be.

J. M.

LETTERS RECEIVED AND SHORT ANSWERS.

J. R. (Malta).—As to "Stars in their Seasons," note advertisements.—MORE LIGHT. Yes; if your facts are "firmley established," you can—as you say—"afford calmley to wait." (You seem, indeed, to take your e's pretty freely.) I really cannot say who is "the best living authority on the subject;" not being quite clear what subject you mean; you only mention your "facts of the weather," which you apprehend I "may think ronsencical" (here you are clearly "half c's over"), "and therefore worthless" (which, if nonsensical, they probably would be); but I don't know what they are. However, on nearly all subjects there is variety of opinion as to who is the greatest authority. As you say, "some old one man and some another."—G. MACKINLAY. Thanks. Both statements relate to cannon balls flying athwart the range of vision, though this is not expressly stated. In mid-flight, which was what I referred to, a cannon ball has not a greater rate than 500 yards per second, even when its initial velocity has been as great as 900 yards per second. I have myself frequently seen cannon balls in mid-flight from behind the gun.—A. PARNELL. Many thanks; an occasional article might find insertion; but, as you may have noticed, space is crowded. The subject is full of interest.—A LEARNER. Six inches square = 3 in. by 1 ft.; that is what was meant.—W. B. No; the question whether a wager is won or not is quite out of our line. Of the wager in question, one can only say that it was vulgar to offer it, unwise to accept it. Science has nothing to do with wagering, except to say that all forms of gambling are essentially immoral.—T. J. DEWAR. Your manner is so rough (not to say rude) that though your matter has been in part useful, it is scarcely worth getting at through such breakers. Hereafter, I fear your handwriting (or signature, if handwriting not recognised) will cause our trusty sub-editor to "basket" your communications rather summarily. If a passer-by flings a stone through my drawing-room window, he would probably be removed by A 21 before I had learned from him that he only wanted to give me his opinion about the kitchen chimneys. I trust I make myself understood. You fling "awful rubbish" at my head or that of a valued contributor—'tis the same thing: do you suppose I go beyond that to read your detailed criticisms?—E. A. HOBSON. Many thanks; the Indian observatory most interesting. There is a description of it in one of the earlier volumes of the *Penny Magazine*.—IKE. (1) The position of the earth's axis varies sensibly (to instrumental tests) from summer to winter, through the effects of precession and nutation. (2) Try "York's List of Astronomical Diagrams." (3) See advertised list of lectures. (4) Algebra certainly essential.—H. MALIM. Calculation given this week.—A WORTHY CORRESPONDENT. Many thanks.—TIM J. W. Cannot answer by post.—G. DUNCAN. Thanks; your communication submitted to the proper persons to decide about such matters.—G. JORDAN. The movements of the moon, as seen from all latitudes, north and south, have been in precise accordance with accepted theories. Why should the moon *not* be seen every month in the Arctic regions, seeing that every month the moon is half the time north of the celestial equator?—J. M. Thanks. Puzzle not very difficult. In my own family "our brother" appears in another way. Thus, if widower having a child marries a widow who also has a child, a son by this marriage is for his child and hers "our brother," though they are in no way related by blood.—ZOOLOGIST. Have no idea.—MARY, HOUSEMAID. Not bad, my dear sir, not bad; nay, "the stars and their seasonings" very good—rather *too* good for "Mary, Housemaid." The "combination" [of] accidents impossible. N.B. Anyone who would spell "minute" with two "n's," would spell it with two "i's," *not* "minnute." Both *my* "i's" open so that I C through U with E's.—S. TRURO. See solution this week.—G. W. Really we do not know what you ought to do under the dismal circumstances you mention. When "you start a meal you scarcely know when to finish;" no wonder that at night you "feel weary, and also your eyes are heavy too." The best advice we can give you about over-eating is "Don't." But we are not medical.—W. FITZROY. We do not know how your namesake acted; and the question is not one we should like to ventilate here.—EQUITES. Really, some readers ask curious questions. You say that when riding, the sides of your knees get sore, and you ask how to avoid that trouble. Keep on and it will go off. Besides, its the best way to keep on. If this fails, try riding with the *other* sides of your knees towards the horse; you have no idea how effective that will be (and also look). But why do you ask *me* this particular question? Now, if you were to try the editor of *Nature*, who compares the motion of the earth to the motion of a galloping horse on a smooth plain, of which motion the rider remains—he says—unconscious, you might learn how to save your knees. I have never reached this stage in riding, but still remain emphatically conscious of motion during a gallop, even over the smoothest fields.

SUB-EDITORIAL.

K. L. W., PERPLEXED, J. HAWKINS, M. E. W., H. N. MEDLICOTT, K. R. and N. M., LANGUAGE, HALLOWEEN, and others. Unsuitable—T. J. DEWAR (later communication). See editorial remarks.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By Richard A. Proctor.

Part VI.

LET us next try a few problems—properly so termed—that is, propositions in which something is required to be done. In these, as we have said, the analytical method is nearly always to be preferred. We will begin with a simple example.

Ex. 6.—*On a given straight line describe an isosceles triangle, each of whose equal sides shall be double of the base.*

Fig. 11.

Let A B (Fig. 11) be the given straight line.

Suppose that what is required is done, and that on the base, A B, there has been described the triangle, A C B, in which the sides A C and C B are equal to each other, and each double of the base A B; and let us consider what constructions are suggested.

It seems hardly possible that the resemblance between this problem and Euc. I., 1, should escape the student's notice. He will inquire, then, whether the method of that problem cannot be applied to the present one. Instead of the circle with radius equal to A B, we now require circles with radius equal to twice A B. It is clear, then, that if we produce A B to D, making B D equal to A B, and B A to E, making A E equal to A B (Euc. I., 3), then A D and B E will each be double of A B.* Therefore, if with centre A and radius A D we describe a circle D C F, and with centre B and radius B E the circle E C G, then C, the intersection of these circles, is the vertex of the required triangle. For A C and B C are severally equal to A D and E B—that is, are double of the base, A B.

We will next try the following:—

Ex. 7.—*The point P, Fig. 12, is within the acute angle formed by the lines A B and A C. It is required to draw through P a straight line which shall cut off equal parts from A B and A C.*

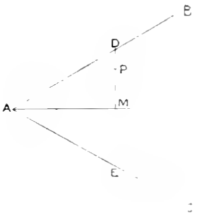

Fig. 12.

Let D P E be the required line, so that A D is equal to A E.†

Then D A E is an isosceles triangle, and it is an obvious course to see whether any of the properties of isosceles triangles will help us to a solution of our problem. Now, the only property of isosceles triangles explicitly contained in Euclid is that of Bk. I., prop. 5. This gives us the angle A D E equal to the angle A E D,—a property which avails us nothing.

But there are other properties of isosceles triangles, not expressly mentioned by Euclid, which every geometrician ought to be acquainted with. We will assume that the student is familiar with them—and indeed they are nearly self-evident. They are included in the statement that the perpendicular from the vertex on the base of an isosceles triangle bisects the base and also the vertical angle. Draw A M perpendicular to *the assumed line* D E; then the angle M A D is equal to the angle M A E, and also D M is equal to M E.

Now let us consider whether this construction affords us any hints:—

First, we cannot see how to draw the line through A perpendicular to *the real line* D E, because it is this very line we seek to draw.

Secondly, we cannot, for a similar reason, see how to draw the line from A to the bisection of D E.

But, thirdly, we *can* draw the line A M, bi-secting the angle D A E.

And this clearly gives us the solution of our problem, since we can now draw D P E at right angles to A M. Thus the solution runs as follows:—

Draw A M bisecting the angle D A E, and through P draw D P M E at right angles to A M; then shall A D be equal to A E. For, in the triangles M A D, M A E, the angle M A D is equal to the angle M A E, the right angle A M D is equal to the right angle A M E, and A M is common to the two triangles; therefore the triangles are equal in all respects (Euc. I., 26), and A D is equal to A E.

The proof of the equality of the triangles M A D and M A E was not included in the prior examination of the problem, since is involved in the assumed knowledge on the student's part of the fundamental properties of isosceles triangles, proved farther on. But, of course, it is well (in a case of such simplicity) to introduce the proof into the solution of the problem.

Let us next try the following problem:—

Ex. 8.—*The points P and Q, Fig. 13, are on the same side of the line, A B. It is required to determine a point C in A B, such that the lines P C Q C may make equal angles with A B.*

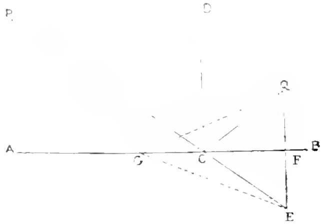

Fig. 13.

Let C be the required point, so that the angle P C A is equal to the angle Q C B.*

Let us try drawing a line, C D, at right angles to A B. Then the angle P C D is equal to the angle Q C D. On a consideration of this relation, however, it seems unlikely to help us. For it is not easier to gather anything from the equality of P C D and Q C D, than to make use of the equality of P C A and Q C B.

It seems an obvious resource, since the equality of the angles, P C A and Q C B, as they stand, is not readily applicable to our purposes, to produce either P C or Q C, in order to see whether the vertical angle either of P C A or Q C B might be more serviceable to us. Produce P C to E. Then the angles Q C B and B C E are equal, or C B is the bisector of the angle Q C E. The only property connected with the bisector of an angle which seems likely to help us is this one, that the bisector of the vertical angle of an isosceles triangle is perpendicular to and bisects the base. Now, we can make an isosceles triangle of which C shall be the vertex and C Q a side, for we have only to take C E equal to C Q, and to join Q E, cutting C B in F. Then, by the property just mentioned, Q E is at right angles to C F, and is bisected in F.

These relations obviously supply all we want. For, reversing our processes, we have only to draw Q F E perpendicular to A B, and

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* We have seen this problem given with the proviso that no problem beyond Euc. I., 1, shall be made use of. In this case the student will see at once that if, with centres A and B, and distance A B, he describes the circles B F E, A G D, then E B and A D, the diameters of these equal circles, are severally double of A B.

† In constructing the figure, proceed thus:—Take A D equal to A E, and join D E; then *take P, a point dividing D E into unequal parts.*

* Construct as follows: Draw A B, and from any point C in A B, draw the *unequal* lines C P, C Q equally inclined to A B. Then there is no risk that accidental relations will appear as necessary ones.

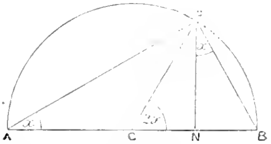
to take F E equal to Q F; then drawing P E to cut A B in C, we are certain that C is the required point. In *all* such cases we should not be equally certain that the *proof* would be as simple as the analysis, since sometimes the reversal of a process involves properties not so readily seen as their converse theorems. In this case, however, it is obvious (or will at least appear on a moment's inquiry), that the proof is simple.

For, join C Q (we are going now through the synthetic treatment of the problem, and therefore ignore the prior constructions). Then, because Q F is equal to F E, and C F is common and at right angles to Q E, the triangles C F Q and C F E, are equal in all respects. Therefore, the angle Q C F is equal to the angle E C F. But E C F is equal to the vertical angle P C A. Therefore the angle Q C F is equal to the angle P C A.

It is an excellent practice, when a problem has been solved, to notice results which flow from, or are in any way connected with, our treatment of the problem. In Ex. 8, Fig. 13, we notice that the line C Q is equal to the line C E, so that the sum of the lines P C, C Q, is equal to the line P E. It might occur to us to inquire what is the sum of lines drawn from P and Q to any other point, as G, in A B. Join P Q and Q G. Then the fact that C E is equal to C Q reminds us that if we join G E, G E will be equal to G Q. Thus P G and G Q are together equal to P G and G E together. But P G and G E are together greater than P E; that is, P G and G Q are together greater than P C and C Q together, or *P C Q is the shortest path from P to Q, subject to the condition that a point of the path shall lie on A B.*

ERRATUM.—On p. 397, 1st col., lines 17 and 18 from bottom, for "a right-angled triangle" read "an isosceles triangle."

GEOMETRICAL PROOF OF THE FORMULÆ FOR DOUBLE ANGLES.



Let A P B be a semicircle, with centre C.
P C N any angle less than 90° ($2x$)
$\therefore$ P A N $= x$.

$$B P N = 90^\circ - P B N = P A N = x.$$

$$\text{Sin } 2x = \frac{PN}{\text{rad.}}$$

$$= \frac{2\ PN}{2\ \text{rad}} = \frac{2\ PN}{AB}$$

$$= 2\frac{PN \cdot AP}{AP \cdot AB}$$

$$= 2 \text{ Sin } x \text{ Cos } x.$$

$$\text{Cos } 2x = \frac{CN}{\text{rad}}$$

$$= \frac{2\ CN}{2\ \text{rad}} = \frac{CN + CN}{AB}.$$

$$= \frac{AN - \text{rad} + \text{rad} - NB}{AB}$$

$$= \frac{AN \cdot AP.}{AP \cdot AB} - \frac{NB \cdot PB}{PB \cdot AB}$$

$$= \text{Cos}^2 x - \text{Sin}^2 x.$$

$$\text{Tan } 2x = \frac{PN}{CN} = \frac{2\ PN}{2\ CN} = \frac{2\ PN}{CN + CN}$$

$$= \frac{2\ PN}{AN - \text{rad} + \text{rad} - NB}$$

$$= \frac{2\dfrac{PN}{AN}}{\dfrac{AN}{AN} - \dfrac{NB}{PN}\dfrac{PN}{AN}}$$

$$= \frac{2 \tan x}{1 - \tan^2 x}.$$

A. D. C. (Cantab.)

Our Whist Column.

By "FIVE OF CLUBS."

THE HANDS.

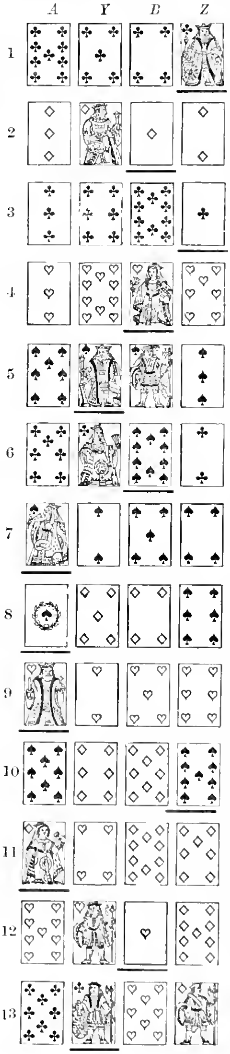
Y.
Spades—K, 2.
Hearts—Kn, 10, 4, 2.
Clubs—Q, Kn, 6, 5.
Diamonds—K, 6, 5.

B.
Spades—Kn, 10, 5.
Hearts—A, Q, 8, 5.
Clubs—10, 4.
Diamonds—A, 10, 8, 4.

Y B
Score.—Love all.
Dealer.
A Z
Trump
S. 3

A.
Spades—A, Q, 8, 7.
Hearts—Q, 9, 3.
Clubs—9, 8, 7, 3.
Diamonds—Q, 3.

Z.
Spades—9, 6, 4, 3.
Hearts—7, 6.
Clubs—A, K, 2.
Diamonds—Kn, 9, 7, 2.



NOTES ON THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. The score being at love, *A* would have been justified, we think, in leading a trump, notwithstanding the weakness of his hand outside trumps. Still there are valid reasons for opening his longest suit; and on the whole, it was, perhaps, the safer course. With *A*'s cards in Clubs, too, it was not unlikely that the suit would be established at the third round. *A* knows that the Two is with *Z*, unless *Y* or *B* is signalling.

2. *Z* opens his long suit. *Y* does not hold the Queen.

3. *B* should have led his own suit, notwithstanding the major tenace. He knows from his partner's lead, himself holding Club Ten, that his Hearts are stronger than his partner's Clubs; and apart from that, the suit is intrinsically so strong that it was his duty to show it. But there are players who never will lead from a suit headed by Ace, Queen. The Club Two is seen now to be with *Z*, Eight and Seven with *A*; Queen and Knave with *Y*.

4. *Z* (Mr. J. Clay) has been blamed for discontinuing here his own suit. But there were good reasons; although the event turned out unfavourably. He knew that the Diamond Queen was held by either *A* or *B*. If by *A*, then a Club lead from *A* would give *B* a ruff, likely enough to suit him, as *Z* holds four trumps himself. If *B* holds the Queen, it is likely that, having no Clubs, he holds one or two more Diamonds, and that *A* holds no more. In this case there is danger of a cross ruff. On the other hand, as *A* led from a weak suit of Clubs, and *B* did not lead Hearts, it looked more than likely that both were weaker still in Hearts, and therefore that *Y* held great strength in that suit. On the whole, though the question is one of probabilities only, Mr. Clay seems to us to have shown his usual judgment in leading what he thought would be his partner's suit.

5. Having made his tenace, *B* might *now*, at least, have enlightened his partner as to the constitution of his hand. If he had led Ace of Hearts, *Z* playing the Six would have showed he had no more. Another lead of Hearts

would either have forced Z, or if, as is probable, Z had refrained from ruffing, A's King would have made. Then a Club lead from A would have given B a ruff; and a final Heart lead from B would have given A a ruff. A small trump lead from A would have given B a trick; the next trick would have been made by A's Ace, drawing the King; then the Queen would have made; and the game would have been won. And though it is not sufficient to point thus to results, we think there can be little room for doubt that the game should have been continued thus. But, like many other players, B, who would not lead from a long suit headed by major tenace, would not play from a suit led by an opponent, though it was clear the opponent had led from weakness.

6. B should have ruffed with the Five, Club Two being certainly with Z.

7. From this point to the end the play is very pretty. A can now place almost every card. He knows that Z has the winning trump and three Diamonds, probably headed by Knave. He knows that B holds the Heart Ace, Y the Heart Knave (for Z can have no more), and trick 4 shows the Knave is not with B. The Knave of Clubs is with Y.

10. Leading the losing trump is the only way to win. It compels Z to lead Diamonds while the command is with the enemy;

11. And thus, while Z cannot bring in his Diamonds, unless B and A make a double mistake (B discarding a Heart at trick 11, and A leading a Heart at trick 12), Y is forced either to discard a Heart, leaving B the full command, or his winning trump, leaving A to make his Club Eight.

12 and 13. A and B make three by tricks and the game.

Note.—The above game is from the *Westminster Papers*, and is interesting as one of the latest in which Mr. James Clay took part.

Our Chess Column.

By Mephisto.

STEINITZ has challenged Zukertort to a match for a stake of about £200 a side, for eight or ten games up. The Chess world will be highly pleased and interested if a match will result from this prompt *défi*.

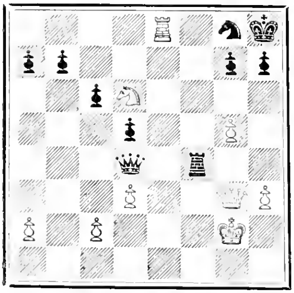
Blackburne, Mason, Bird, and Gunsberg will represent England at Nuremberg. This tournament promises to be a very great success, notwithstanding (oddly enough) that the prizes are very small.

The Counties Chess Association will, we believe, hold its annual gathering at Birmingham in the first week of August.

The following exceptionally fine ending occurred in actual play at Purssell's, Cornhill:—

Amateur.

Black.



White.

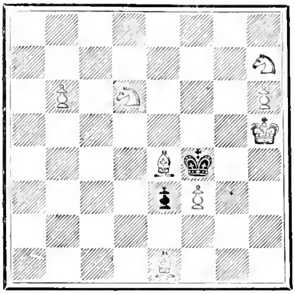
J. Robey.

White to play and win.

PROBLEM No. 86.

By C. Planck.

Black.



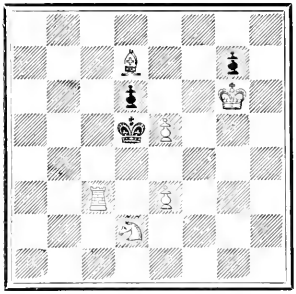
White.

White to play and mate in three moves.

PROBLEM No. 87.

By J. C. S.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Amateur.—We do not know the book published in 1882.

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Part XX. (June, 1883), just ready, price 1s., post-free, 1s. 3d.

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PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 13, 1883.

CONTENTS OF NO. 89.

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

THE figures now given illustrate the descriptions in the last paper, and show some of the principal varieties of infusoria. They will also enable some interesting questions concerning their movements to be considered. Motion that looks more or less like voluntary is by no means confined to the animal world. Motile spores of algæ, for example, are very common, and there are few objects more fascinating than the exquisite emerald-spangled globes of volvox swimming with the aid of numerous cilia. There are no sharp boundaries between the animal and vegetable worlds, but as advances from the lowest forms are examined, a positive preponderance of character is discovered. Speaking generally, the respiration of plants is like that of animals. They absorb oxygen and evolve carbonic acid; but they can also digest that acid, and use its carbon to build up their structures, which thorough animals cannot do. The chlorophyl of plants is the agent for effecting this process, and a few animals which possess it—Euglenæ, for example—may have a similar power. In proportion as organisms exhibit decidedly animal characteristics, we might expect their movements to appear more like the *will*-directed actions of the higher orders, and this is generally true. When moving objects jostle together, go to the edge of a containing cell and stick there, or in any other way appear blundering, they probably belong to the vegetable world. Mr. Saville Kent, whose opinion is entitled to great weight, finds that as a rule the animal types "make tentative, well-controlled progress in various directions, and intelligent deviations." Let us investigate this. Fig. 1 shows a minute creature (*Heteromita lens*) with a small whip; the little group of dots are its spores. The magnification is 800 linear. Many much smaller objects swim skilfully by means of similar whips. In this group and in many others, Mr. Kent observes that the movements seem to be intelligently guided. It is impossible without intolerable circumlocution to speak of these things with accurate precision. In using such a word as intelligence, it does not mean the same as if it were applied to a human being, but something on a lower platform, in some respects resembling it. Fig. 2, *a* and *b*, are *Euglena* (*E. viridis*). They were formerly placed by most authors amongst the plants, but Mr. Kent confirms the observations which assign to them a small mouth, and he succeeded in inducing them to swallow minute particles of carmine. On this, and on other accounts, he claims them as animals.

On a sunny day, go to a quiet pond that is covered, or streaked, with a thin scum, like green-pea soup. Skim a little into a bottle, and the capture most likely consists of myriads of beautiful little fish-like things of emerald lustre, with a so-called ruby eye-speck. These are *Euglenæ*. There are several species; the commonest—the one figured—varies from 1-1150″ to 1-240″ in length. The bottle containing them should be kept in the light, to promote their development. In the dark they sink to the bottom; the light brings them to the surface. They are furnished with a remarkably elastic integument, and can assume all sorts of odd shapes, or a globular one. Our object now is to watch their swimming. A drop of the water containing them is placed in a little glass cell, 100th of an inch deep. This gives them plenty of room for moving at different depths. A half-inch objective, with A or B eye-piece and dark-ground illumination, shows them off well. Continual watching rarely detects a collision. For hours together they swim backwards and forwards, this way and that, often with sudden changes of direction as sharp as those of a swallow or bat. If one is comparatively quiet, a little ripple amongst floating particles proclaims the motion of the long, whip-like swimming organ, but the lash itself is invisible, or very troublesome to see with any power while the creature is active; and when it rounds itself, and lies still, it is not displayed. To see it, put a droplet of tincture of iodine, as big as a pin's head, on a glass slide; then add a rather larger droplet of water containing the creatures; put gently over them a thin covering glass. They all die off-hand, and the whips are then so plain that we wonder they were not seen before. They are rather longer than the animal, and their arrested motion leaves them in wavy or twisted patterns. The swimming is sometimes assisted—perhaps entirely caused—by contractions and expansions of the integument; but often the queer changes of shape must make it more difficult for the whip to move the creature, as it does, in a definite way. Fig. 5 is a Paramecium, with plentiful rows of cilia, but its motions are not so wonderful as those effected by the whip of the *Euglena*. Where a cilium is highly magnified, and its motion becomes slow as the water dries up, it is seen to be much like what can be done with a long flexible cane, held in the hand, and worked by sharp turns of the wrist. A wave motion runs from the base to the tip. When an animalcule uses a quantity of these organs, rhythmical agreement is the chief thing necessary; but how to row a canoe with a whip-lash is quite another matter. Whips and cilia are commonly described as the same things, only differing in stiffness. Watching the work of the whips leads the present writer to regard them as very different things. The *Euglena* has its whip at the mouth (red speck end), and it pulls itself forwards through the water, with rapid changes of direction. It is impossible to conceive this could be done by moving the whip by an impulse from its base only, as is the case with cilia. The whole length of the whip appears highly vitalised, while the cilium is only an elastic bristle of a delicate description. A curve at any part must modify the direction of the currents produced by its lashing, and as the motions always look skilful and purposeful,

each portion must concur with the rest, just as much as the several joints do in a prehensile monkey's tail. Many infusoria have a plurality of whips at their anterior end. Fig. 4, *Amphimonas dispar*, has two; Fig. 3, *Cercomonas acuminata*, has one at each end, and it must want some skill to prevent their motions from conflicting.

Fig. 6 represents *Euplotes patella* in two positions. The under side is exhibited in *a*, and *b* gives a profile view. This creature swims with its cilia, or walks with its bristles. Intelligence, or a sufficient substitute for it, guides the animal to the right use of these two sets of organs, but nothing in the locomotive line done by the ciliata, or heterotricha, is so wonderful as the *Englena* whip work.

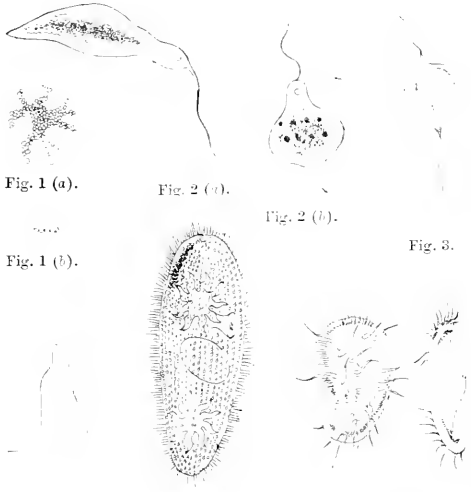


Fig. 1 (*a*). Fig. 2 (*a*). Fig. 2 (*b*). Fig. 1 (*b*). Fig. 3. Fig. 4. Fig. 5. Fig. 6 (*a*). Fig. 6 (*b*).

Fig. 1. *a* and *b*, represents the spores and young of Heteromita lens, × 800. Fig. 2, *a* and *b*, Englena viridis in two positions. × 250. Fig. 3, Cercomonas acuminata, × 500. Fig. 4. Amphimonas dispar, × 300. Fig. 5, paramecium aurelia, × 75. Fig. 6, Euptotes patella, *a*, under side; *b*, walking attitude, × 140.

When any bird or insect does a skilful-looking thing, it is popularly said to be directed by *instinct*, but few persons endeavour to mean anything really intelligible by the term. Instinct in birds and insects, for example, is not, as often asserted, unerring; it does not compel the creature always to do the same thing. It does not preclude experiment, and, to a certain extent, a modification of plan and use of new materials. Instincts are probably inherited aptitudes, and in their higher exhibition are associated with reason. What are we to say of the lower and of the far minuter objects that perform acts of locomotion, food-seeking, &c., in a way that must be called skilful, and which would be impossible unless their bit of protoplasm had molecules so arranged as to perform work analogous in character to the nerve actions of higher animals? They must receive impulses from without, and send forth the right sort of impulses in reply to them. To avoid an obstacle means taking some physical cognisance of it, and directing the motile organs accordingly. To move after prey with aspect of skill requires some faculty of recognising where it is, of distinguishing it from other things, and of steering accordingly. Do these minute creatures think? No one supposes that they are conscious of their existence; that they reflect upon the sense impulses they receive; or that they knowingly exercise a will force, or have such a feeling as desire; but, after dismissing as improbable the attributes that belong to animals with an elaborate nervous organisation, there is much to be accounted for that differentiates them very strongly from inorganic matter, and that prefigures some, at least, of the mental processes of higher beings.

In investigating the phenomena of living beings we soon feel that we are in the presence of an unknown something which is not like any merely physical or mechanical force.

The iodine solution may be made by dissolving one grain of iodine and three of iodide of potassium in one ounce of distilled water. Half the quantity is an abundant stock for the numerous experiments for which iodine is useful.

CHEMISTRY OF THE CEREALS.

By WILLIAM JAGO, F.C.S.

No. 1.

THE name "Cereals" is applied to the group of grasses cultivated for human food; included in their number are wheat, barley, rye, oats, maize, and rice. As a result of analysis we find these bodies to consist in great part of organic compounds, together with a small proportion of inorganic material. This latter, derived from the soil on which the plant has grown, contains potassium phosphate, magnesia, lime, silica, and minute quantities of other ingredients. Our present purpose leads us more especially to the study of the organic constituents of the members of the great grain family; these bodies are themselves of inestimable value to man, and further, by virtue of certain chemical changes, yield a number of other most useful and interesting products. Subjoined is a table giving the average composition of the cereal grains:—

	Wheat.	Barley.	Oats.	Rye.	Maize.	Rice.
Water	11·1	12·0	14·2	11·3	11·5	10·8
Starch	62·3	52·7	56·1	54·9	54·8	78·8
Fat	1·2	2·6	4·6	2·0	4·7	0·1
Cellulose	8·3	11·5	1·0	6·4	14·9	0·2
Gum and Sugar ...	3·8	4·2	5·7	11·3	2·9	1·6
Albuminoids	10·9	13·2	16·0	8·8	8·9	7·2
Mineral matter ...	1·6	2·8	2·2	1·8	1·6	0·9
Loss, &c.	0·8	1·0	0·2	0·5	0·7	0·4
	100·0	100·0	100·0	100·0	100·0	100·0

We see from this table that water is present to a greater or less extent in all. wheat and rice containing the least quantity. The sample of wheat was, however, an old one. and therefore will have got drier by keeping.

We also see that starch is by far the most abundant constituent of these grains; its percentage ranges from 52·7 in barley to 78·8 in rice. The first step, then, in the study of the chemistry of the cereals will be to make ourselves acquainted with the nature and properties of this body. The composition of starch is represented by the formula $C_6H_{10}O_5$. Its general appearance is well known, for, besides being largely used for laundry purposes, we find it occurring in a considerable number of other preparations; thus "violet powder" is, or should be, pure starch, scented with orris root, and the various "cornflours" are simply the starch of maize. Let us take a sample of starch as sold by the chemist and examine it. We have a fine white powder, which, on being pressed between the fingers, produces a peculiar sound, known as "crepitating." An examination under the microscope shows that this powder possesses a very marked struc

ture; writing with that instrument before me, let me describe the observation I have just made. Having obtained a little potato starch, and, in addition, some arrowroot (also a starch), I placed a drop of water on a clean slide, then the smallest pinch of starch, and, finally, very gently pressed down a cover glass. I then looked at each sample with an eighth objective. Taking the potato starch, it is readily seen to be composed of little granules; some of these are spherical, others, which are older, are shrivelled, and have polygonal outlines; some of the more favourably-situated corpuscles show a series of ring-like markings. This latter peculiarity points to these particles having a concentric structure, somewhat like that of an onion. Viewed by polarised light, with crossed nicols, a black cross is seen in each granule. Looking at the arrowroot, the first point noticed is that the granules are larger, and of a different shaped outline. Their form reminds one of the shape of a mussel-shell, and the ring-like markings start, like those of the shell, from a point near one end; using polarised light, the black cross is again seen distinctly, but its arms are no longer at right angles; the centre of the cross also coincides with the point around which the markings are concentric.

These little starch corpuscles of which we have been writing consist of an outer envelope of starch cellulose, a substance closely allied to starch, and of granulose, or starch proper, which constitutes the interior of the granule. Starch, as far as we know, is not dissolved without change by any known liquid. This is, in fact, exactly what we might expect, because starch possesses an organised structure; when once that is destroyed by solution, it can never be restored by simply driving off the liquid; for though by evaporation we may thus obtain, of certain substances, crystals of perfectly regular shape, it is impossible, without the aid of life, to build up organised structures. Cold water is absolutely without action on starch; but take a small quantity and, having shaken it up with water, gradually heat, the starch swells up and forms a thick paste. By the action of heat, the starch granules are ruptured and the interior granulose dissolves; the addition of a large quantity of water renders the starch almost entirely soluble; the little envelopes, however, remain, and may be filtered off from the solution. It is a matter of uncertainty as to whether this soluble starch is chemically or only mechanically distinct from the insoluble form. Before dealing further with the chemical constitution of starch, it will be well to inquire a little into how starch is obtained from the different substances containing it. If a small quantity of wheat-flour be taken and wrapped in a piece of muslin, and then kneaded between the fingers in a small basin of water, the water becomes milky, and there remains behind, within the muslin, a tough glutinous substance, termed gluten. Of this we shall have to say more a little later. Let now the water stand; it gradually becomes clear, and deposits a white powder at the bottom of the basin. If now the water is poured off, and the powder allowed to stay, a fairly pure sample of starch is thus yielded. In manufacturing starch on the large scale, wheat is first coarsely ground, and then wetted with water; on being allowed to stand for some days, fermentation sets in. The wheat is then transferred to large vats, and additional water added; fermentation goes on apace, and the gluten putrefies, evolving a most offensive odour. Certain acids (acetic and lactic) are formed as a result of fermentation, and these dissolve any remaining gluten. The remaining starch is next thoroughly washed and subsequently dried. During the latter operation the masses of starch shrink and split up into the columnar structure so well known in laundry starch. A considerable quantity of starch is also manufactured from the potato. The principle is much the same: the tubers are first washed, then rasped into a pulp, and washed on a sieve; the water, which runs through milky, from the presence of starch granules, is allowed to stand until it deposits its starch; the sediment is then carefully washed and dried. As the potato contains no gluten, the process of putrefaction necessary with wheat is not required. It was before mentioned that "corn-flour" is the starch of maize: in its preparation the disagreeable method of removing gluten by putrefaction is avoided by using a very dilute solution of soda as a solvent for that compound. The gluten is thus first dissolved out, and the remaining starch is washed and dried. In this manner is yielded a very pure and elegant form of starch. While, as a preparation of starch for food-purposes, corn-flour leaves nothing to be desired, it should never be forgotten that it is, after all, starch, and starch only. That cheapest form of starch, viz., that of the potato, has recently been brought into the food market under the name of "potato fécule;" *fécule*, be it remembered, is simply the French name for starch. A glance at the table given at the head of this paper shows rice to be almost entirely composed of starch. For the great majority of purposes where starch is required as an article of food, there is no better substance to use than rice, either in the form of the whole grain or ground into meal by passing through a small hand-mill. The difference in cost of rice compared with that of these other starch products is well known to every prudent housewife.

GEOLOGY AND AGRICULTURE.

By J. Vincent Elsden, B.Sc. (Lond.), F.C.S.

II.

THE quantity of water carried down by rivers depends also upon the strata over which they flow. Thus the Medina, in the Isle of Wight, is a very narrow stream while in the chalk district, but widens out immediately on reaching the less permeable Eocene beds. Indeed, limestone districts can frequently be traced on a map by the absence of streams and rivers. The Thames affords a striking illustration of this influence of geological structure upon the discharge of rivers. In flowing over Lias clay, it is estimated to discharge 320 cubic feet per minute, but coming to the porous Oolitic strata, its discharge suddenly falls as low as 10 cubic feet per minute.

The quality of the water is also influenced by the composition of the rocks through which the river flows; and considering the large amount of irrigation which is carried on in many agricultural districts, the composition of river water is of the first importance to the farmer. Thus, in Surrey, the water of the Mole is far superior to that of the Wey for irrigation purposes, for the Mole, after traversing the Weald, flows through calcareous strata, and becomes impregnated with fertilizing mineral substances; while the Wey flows almost entirely through barren sandy districts. The water from the Lower Greensand of Surrey is also ill adapted for irrigation on account of the very small amount of mineral matter dissolved in it; nor is it a matter of any surprise that the Lower Greensand itself should form here so barren a soil, considering the small amount of soluble material which it yields. The water from the Carboniferous limestone of Yorkshire, on the other hand, is known to be extremely useful as a fertilizing agent; while the remarkable excellence of the water-meadows of Gloucestershire is

attributable to the fact that they are watered by streams from the highly calcareous rocks of the Cotteswolds. Perhaps in no county in England is irrigation less practised than in Warwickshire—a fact which is easily explained by the physical features of the district, for the majority of its streams originate in the elevated plateau around Birmingham, known as the *watershed of England*, and have not yet been long enough in contact with the rocks to have acquired enough dissolved mineral matter to make them valuable as fertilizing agents. Just as a fertile oasis marks the position of a spring of water in the parched and barren desert, so, though in a less degree, is the fertility of our English soils influenced by the peculiar character of the water of each geological formation. The saliferous marls of Staffordshire give rise to such brackish streams, that on their banks sea-side plants are frequently to be found; but the injurious influence on agriculture of an excessive amount of soluble matter in the underlying rocks is best seen in the immense natron plains of Hungary, between Arad and Debriczin, which are rendered unproductive by an efflorescence of soda-salts from the soil; while in some low tracts of land on the shores of the Mediterranean, which are too salt for cultivation, it has been found necessary to remove the saline matter by artificially flooding with fresh water, and afterwards draining.

Perhaps no geological agency exerts so much influence upon agriculture as denudation—that slow and silent action whereby the surface of the earth has been moulded into its present form. Thus the mechanical action of running water acquires an agricultural interest almost as great as its chemical influence, which we have just considered. Not only are immense quantities of the most productive soils carried away by this means, but by being deposited in other localities, the most fertile admixtures are often produced. This accounts for the great improvement which soils usually exhibit near the outcrop of other formations. The peculiar fertility of the hop district of Farnham is due, to a great extent, to the many outcrops, in a small area, of beds of different character, and to the consequent mixing of different soils. The great value of alluvial soils, also, is to be explained by this natural admixture of sediment carried down by running water from strata varying in mineral composition. The Golden valley of Herefordshire owes its superiority to a fertile alluvium derived from the cornstones of the surrounding Old Red Sandstone formation. So valuable, indeed, is the detritus carried down into the sea by rivers, that, in favourable localities, the flood-tide is made, by artificial means, to overflow the fields around and to deposit its precious freight of fertile mud upon the farmer's land. The inundations of the Nile are beneficial to the soils of Egypt only in proportion to the quantity of finely-divided sediment which is thus deposited upon them, and Duponchel has even conceived the idea of fertilising the barren *landes* of Gascony by artificial warping from the Pyrenees. This artificial admixture has been practised with great success in many parts of England, and many a barren soil has been rendered productive by the processes commonly known as claying, marling, and chalking. By judicious admixture of materials from neighbouring strata, many of the waste lands of England have been permanently improved, and have increased in value both to the owner and tenant.

But if advantage is gained by the farmer who cultivates the rich alluvial tracts, the fertility of which may be traced to the nature of, perhaps, distant strata, it is far otherwise with those from whose land the sediment has been transported. In many districts agricultural operations are seriously impeded by the rapidity with which the soil is removed by denudation. This is nowhere so well shown as on steep slopes, such as the sides of the granite hills of Cornwall, or in incoherent soils like the Black Earth of Russia, in which huge ravines are formed with surprising rapidity, and the most fertile alluvium in Europe quickly swept away.

The presence of igneous dykes seems invariably to exert a beneficial influence upon the soil. In some parts of Cornwall, where the general rental of the land is about thirty shillings an acre per annum, the accidental occurrence of an igneous dyke improves the land to such an extent that the produce is nearly doubled, and the rental consequently increased. In a similar way the Carboniferous limestone soils of Derbyshire are greatly improved by the presence of those volcanic rocks which are locally known as *toadstones*, and in some parts of South Wales, where traprocks occur, an otherwise barren soil is completely changed and rendered capable of producing nearly every crop. It is interesting to note how quickly the lavas and ashes of Etna are transformed into vineyards or gardens by the ceaseless industry of the husbandmen, even although they are repeatedly destroyed by fresh eruptions.

It generally happens that in those localities where the nature of the rocks has resulted in the production of the most pleasing scenery, there agriculture is least developed. Of course, where the scenery is bold and mountainous, we shall expect to find great hindrances to agricultural operations; but even in districts such as the Isle of Wight or Surrey, we find a pleasing landscape accompanied by a most backward state of agriculture. Nor does it often occur that great agricultural value characterises those districts which are famous for their mineral wealth. The mining districts of England are chiefly noticeable for the general unproductiveness of the soil, which is sometimes so poor that three or four shillings an acre is the utmost rental that can be obtained.

Enough has now been said to show the general connection between agriculture and geology. In the New World, where there is no lack of available ground, colonists need cultivate only the most favourable districts—the alluvial plains and valleys watered by running streams; but the crowded population of Europe necessitates a continual struggle against natural agencies to improve every available spot. Thus by ceaseless toil and industry the greatest obstacles have been overcome. The natural aridity of Egypt, the deficient water-supply of Lombardy and Tuscany, are conquered by the most careful irrigation; wastes have been reclaimed; marshy tracts have been rendered fertile by draining; the hills on the banks of the Moselle and the Rhine and the steep slopes of Provence, in spite of the rapidity with which the soil is washed away, are kept clothed with vines, corn, and olives by the endless toil of terracing the hill-sides, and thus overcoming the obstacles which nature has opposed to successful cultivation.

THE HIGHEST BRIDGE IN THE WORLD.—This is the railway viaduct of Garabit, in France, now being erected over a river in the department of Cantal. The total length is about 1,880 ft., and near the middle of the great centre arch, the height from the bed of the river to the rail is 413 ft. The viaduct was begun in 1881, and is to be completed next year.

THE longest bridge in the world is said to be in China, at Sangang, over an arm of the Chinese Sea. It is five miles long: the roadway is 70 ft. high, and stands upon 300 arches. The parapet is a balustrade, and each of the pillars, which are 75 ft. apart, supports a pedestal on which is placed a lion 21 ft. long, made of one block of marble.

AUSTRALIAN ANTS.

(Continued from page 374, Vol. III.)

THE tree-ants are very frequently met with. Of these there would seem to be at least two species, the one contenting themselves with nestling under the loose bark, while the other bore into the trunk of the tree itself, by reason of which habit they are designated carpenters. They do not, however, use timber for building purposes: they only excavate it to provide themselves with a dwelling-place; still, as the particles of wood lie scattered round the root of the tree, looking like heaps of regular sawdust, the designation seems by no means inappropriate. A favourite resort of both these species is dead stumps, and, singular to say, three sides only of the stump are appropriated. These are invariably east, north, and west. These several sides, as every one will remember, are the only ones well exposed to the sunshine, necessary in winter for the comfort of the community, and in spring, summer, and autumn for the hatching of the eggs and the development of the pupæ. A sanitary expert could not have devised his plans more satisfactorily. These ants are very fierce when molested, attacking some of the larger kinds, and often come off conquerors.

The little "sugar ants" are well known to most dwellers in towns, and even in central Melbourne sometimes prove a nuisance to housewives, by invading any saccharine matters that may be left uncovered. They owe their popular name to their fondness for this article of food. If a small heap of the same is placed in their way, they seldom stop to eat it on the spot, but carry the prize away, crystal by crystal, evidently for the benefit of the general population. Fond as they are of sugar, they are still more partial to honey, and will readily leave the former for the latter. This is not carried away, but eaten wherever met with. So attractive seems this ambrosia, that even the queens are tempted out to partake of it. Before depositing the honey I once or twice introduced some stranger ants, who were immediately attacked. While the fight was going on I placed the honey near the belligerents, who, as it seems, having more taste for the pleasures of a terrestrial Valhalla than the turmoil of the battle-field, let go their antagonist to feast with their already nearly gorged *confrères*. On one occasion two combatants fell into the honey. The stranger, owing to superior strength escaped and was followed by a little crowd of his enemies. The object of the pursuers, however, did not seem to be the further punishment of the interloper, but simply to despoil him of the dainty which he was carrying away adhering to his legs and body. If a working ant fell into the honey he was left contemptuously alone to escape as best he could. On two occasions, however, I noticed queens who had similarly come to grief. These, strange to say, were pulled out and cleaned by three or four of the adjacent workers. With respect to queens, there seems to be a good deal of gallantry displayed towards them, altogether independently of nation or race. I have never, in fact, seen a strange queen molested when placed among hundreds of a thoroughly hostile tribe. I once noticed another remarkable fact with respect to the behaviour of ants towards strangers. I had placed some ants fully a quarter of an inch in length upon a board surrounded with water. Soon afterwards I brought home a number of tree ants, together with some twenty or thirty queens and several hundred pupæ, placing my second find at the opposite end of the same board. I fully looked forward for a fight, and so there was, but not as was expected. The tree ants at once began to seize and carry off the pupæ, and in the direction of the stronghold of their gigantic fellow-prisoners. Queens, as before stated, were allowed to pass unmolested, as also, in most instances, were unladen ants, but an ant bearing a pupa or egg in its mandibles was at once assaulted and nipped by some assailant. The pupa was, of course, dropped, the despoiled bearer thereof creeping away badly, sometimes fatally, wounded. Singular to say, the dropped pupa was never appropriated by the attacking party. His object seemed to be murder, to which he was incited for some unknown reason, and not robbery.

Perhaps of all Australian ants the so-called bulldog is the most noticeable. These do not seem to exist at present in any great numbers near Melbourne, although during a walk through the more unfrequented part of woods and paddocks some few are almost certain to be met with in the summer months. Their mandibles are very large, but do not appear to be of the shape especially adapted for wounding the human skin. Their principal means of defence and attack in all probability lies in their formidable sting, a wound from which, although by no means dangerous, is often painful. Their name is most likely derived from the singular habit they have of always facing their enemy bull-dog fashion. It is very rarely that you can make them take to flight. They rather choose to maintain their ground, and assume a threatening attitude. Held captive under a glass, I have frequently seen them attack spiders many times their size, and armed with formidable jaws. The spider, however, is a dangerous adversary, his flight being often attended with mishap to the pursuing party, since the fugitive has a habit of playing a thoroughly Parthian trick during his retreat, not, however, shooting an arrow, but darting out a series of webs, which adhere to, and generally disable, the enemy. Bulldog ants would seem to have some idea of colour, and, like the bovine monarch defending his seraglio, have an especial antipathy to objects of a bright ruddy tint. In confinement, at any rate, I have seen them fairly rush at a piece of scarlet silk, seizing it with apparent fury, and holding thereto for several seconds. Although not very numerous near town, they seem to be holding their own in some remote parts of the colony. According to Mr. Selwyn's geological reports, issued some fifteen years since, a party of his surveyors were literally driven out of a district near Cape Howe by swarms of these pugnacious little animals.

A remarkable kind of ant is sometimes met with near town. It is of a metallic sap-green colour, usually of about five-eighths of an inch in length, rather lively in its motions, but not, by all accounts, given to either bite or sting. Its defence is the singular attitude which it takes up when an alarm is given or an enemy approaches. It suddenly elevates the abdomen so that this stands nearly perpendicular. In this position it may really appear very formidable to some would-be assailants, although man is not likely to be greatly intimidated thereby. This particular ant seems to be especially addicted to solitary habits, and it is on very rare occasions that as many as two are seen together. It would also seem to be of the female sex, which, in this instance, is not formed according to the general rule. On the other hand, the males are capable of flight, are of much smaller size, and very sluggish in their movements. At the proper season a female is often seen followed by some five or six of her male admirers, who, with their slow motion and the rather peculiar arrangement of their wings, remind one of a group of languid swells clad in ulsters, and with well-bred lounge dogging the footsteps of some reigning belle as the latter coquettishly "does the block" on a fine afternoon.—*Australasian.*

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

A popular account of the principal Sea Anemones in Tank No. 10, and the Subsidiary Vases.*

By Thomas Kimber, M.A., Lond.

THIS exhibition of sea anemones as a whole is probably the largest, if not the most varied, collection that has ever been made. Many of the examples here displayed are of extraordinary beauty, much exceeding in size those usually obtained, while in freshness and depth of colour they could not be surpassed, and have rarely been equalled. The very great difficulties invariably attending the setting up of an aquarium appear at length to have been successfully surmounted, and the tanks, if not yet quite bright, are brightening, and are becoming increasingly attractive and more interesting, and daily drawing larger numbers of visitors to inspect and examine them. That the readers of KNOWLEDGE may take an enhanced interest in this very popular department of the Exhibition, it is proposed to give, first, a short introduction, and, afterwards, in separate articles, descriptions of the choicest anemones to be seen in the Exhibition, with sufficient details as to outline, colour, and dimensions, that each may be easily recognised, and also to add a few words on their habits and the localities in which they are generally found.

All living beings are endowed with organs or means of providing for nutrition and reproduction which are absolutely necessary for their existence and continuance. These are called organic functions, because all organic beings possess them; they have, too, been called *vegetable functions*, because in vegetable life these organs alone are found.

Sensation and motion occur in animal life, and are called *animal functions*. This restriction of *two* living functions to plants, and its extension to *four* in animals, draws the line between plants and animals.

It was for a long period held that many of the lower animals which have a manifest resemblance in external form to plants participated in the functions of both. They were supposed to be plants endowed with animal properties, and were hence called *zoöphytes*, that is, animal plants. The name is still retained, though now their true place amongst animals is fully accorded to them. From their likeness or fancied resemblance to our most elegantly fringed and radiated flowers, the names anemone, sunflower, carnation, marigold, were respectively applied to several species by Ellis, a London merchant, who has given a very accurate account of these animals as observed by him a hundred years ago. He has been called the father of English Zoophytology. Independently of the above popular appellations are the names assigned by naturalists, which are generally derived from Greek or Latin roots, and have reference to the character or structure of the object named. *Actinia* (Gk. ἀκτίν, a ray) is the scientific name of the genus sea anemones.

To economise space, and to make our descriptions more exact, we premise a few definitions.

The parts of an anemone—considered as an animal plant—to be described are :—

1. The root, called the base or foot.
2. The stem, called the column or body.
3. The flower, called the disk or face.

1. The foot (*basis*), by which the animal adheres to rocks or shells.

2. The body (*columna*), may be smooth (*lævis*), warty (*verucosa*), longitudinally furrowed (*sulcata*), transversely furrowed or insected (*insecta*), if the intersections are deep or constricted (*constricta*), if crossed by lines or furrows, *i.e.*, cancellated (*cancellata*), if rough like the bark of a tree or corrugated (*corrugata*). The substance may be leathery (*coriacea*), fleshy (*cornosa*), pulpy (*pulposa*). Warts on the column are often suckers (*acetabula*). At its summit (*vertex*) the column is cut off in a transverse direction, and a margin (*margo*) is formed. In some cases the margin rises and forms a parapet (*tichium*). Between the margin and the feelers or tentacles (*tentacula*) there may be a groove or foss (*fossa*). The margin may be notched (*crenata*), or formed of tentacles, *i.e.*, tentaculated (*tentaculata*).

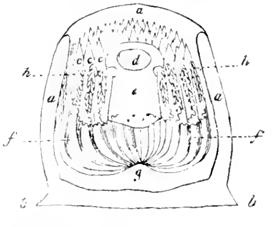
3. The disk (*facies*) is the flat top of the column. It is either plane (*plana*), wavy (*undulata*), lobate or frilled (*sinuosa*). In the centre of the disk is the mouth (*os*), with lips (*labia*). Converging lines on the disk are *radii*. Two radii, strongly marked, on opposite sides of the mouth are gonidal radii (*radii gonidales*). From the surface of the disk spring the tentacles or feelers, which are hollow cones, with a root (*radix*) and a tip (*apex*).

Flower (*anthus*) is the term used to describe the anemone when the disk with its tentacles are expanded.

Button (*oncus*) is employed to explain that the tentacles and disk are retracted or concealed.

Sea anemones are the *Actiniæ* of Baron Cuvier, a genus of the *Acalephæ* (nettles), which again forms his third class of *Zoöphytes*. The internal structure of the anemone has been carefully investigated, to show which we give a vertical section for reference.

THE DAHLIA, *Actinia coriacea*, Cuvier.



a a a. Tegument, *septum.*
b b. Foot by which the animal attaches itself.
c c c. Three rows of tentacles.
d. Mouth.
e. Stomach.
f f. Longitudinal muscles.
g. Point in which they unite.
h h. Ovaries which open into the stomach.

Generally anemones can at pleasure either attach themselves, or creep, or float. The cold weather drives them from the shore to deeper water. On changing their abode, some creep along the bottom, some abandon themselves to the waves, and others, it is stated, turn themselves inside out, and use their feelers as feet. The longitudinal muscles shown in section above conduct to the tentacles placed round the creature's mouth, and are believed to be the tendons which move its feelers at the will of the animal. The actiniæ are incommoded by a strong light, noise startles them, they are affected by odours, and fresh water kills them. They may be cut perpendicularly or crosswise, and each cutting will usually live and become a new animal.

* Another and, perhaps, almost the most attractive branch of the aquaria is that which contains the anemones, for the finest specimens of which the Committee are indebted to the Directors of the Brighton Aquarium, who have given every assistance to procure a thorough and handsome collection.—*Official Catalogue*, page 148.

They also issue already formed from the mouth, and sometimes a portion of the base is severed, continues to live, and in time grows into a complete actinia. Actiniæ feed, in their free, natural condition, upon medusæ and other small crustaceous and molluscous animals, which they seize with their tentacles, and afterwards disgorge what they cannot digest. In aquaria they are fed successfully upon fragments of meat. Many species are eaten as a delicacy in tropical countries, where they are much more numerous than on the British coasts.

MR. LESLIE STEPHEN ON THE INFLUENCE OF SCIENCE.*

"IF it were a qualification for his office," Mr. Stephen remarked, "to be impartial in the sense of not having an opinion on the matter, it would have been hardly possible to select a less qualified chairman in all London than himself. He believed that the spread of scientific influence had not only not been bad, but that the thing of which we stand most in need is a great deal more scientific thought and method in every direction. He felt, however, that his case was so strong that he could afford to give points to the opposite side; and for this reason, and because, to a certain extent, he was prepared to go with the opener in his remarks, he hoped to be able to point out fairly where the various arguments which had been used found their proper place. The only definition, or rather description, of science which ever appeared satisfactory to him was that—Science is that body of truths which may be held to be definitely established, so that no reasonable person doubts them. To speak of mischievous science is, therefore, to assert that truth is mischievous, an assertion to which no one would be likely to seriously agree, especially in such a place as University College. If it is to be supposed that science is mischievous, it must either be meant that certain false theories which call themselves science are wrongful, which may well be the case, or that the scientific progress at the present time happens to be exercising a mischievous influence.

"No one denies that science may accidentally lead to a large number of our particular mischiefs, as in the case of the invention of dynamite; but it cannot in any way be admitted on that account that science is mischievous. For the question arises, if science is bad, what can be substituted for it? and in what way will these mischiefs be remedied if we are not scientific? It is impossible to say that erroneous impressions will make us better off than correct ones. For instance, the old belief in medicine subjected people to years of torture because of supposed witchcraft. In India it is still believed in some parts that smallpox is a demon, and efforts are made to propitiate it, so that, if unnecessary torture and small-pox are evils, we are better for the light which the scientific man has thrown on these subjects. Still it must be admitted that in particular ways the development of science has produced new evils as well as new benefits, and for that matter no sort of progress is made without collateral evils. But the question then remained as to the remedy, and in his opinion that remedy could be very shortly described as more science and not less. There is no sort of conflict between a scientific and a literary education. Everybody ought to have some literary knowledge, and everybody ought to be taught the first principles of science; even a smattering of chemistry might be useful in a literary pursuit. He himself had found what little smattering of science he had acquired at Cambridge and elsewhere of the greatest use in every other kind of study. The habits of thought and feeling acquired by the study even of mathematics, which he took to be the most uninteresting science there is to most individuals, are very useful when one comes to need accurate thinking anywhere, even in matters purely literary.

"It had been urged that science prevents a man from taking the same sort of pleasure in nature as he would do without it. Wordsworth was very fond of saying this, and of denouncing generally the scientific position. But the reason of that was that Wordsworth knew nothing about science. The result was that there is no other instance of so great a poet leaving off writing great poems so early in his career. All his finest poems were written in his early life; and the reason is that he went mooning about the mountains by himself, and did not get any new thoughts. In contrast to him Goethe stands out as a man great in both science and poetry, and is a typical example of the way in which they react on one another. Whenever it was suggested that science is opposed to a love of nature, the speaker always thought of the greatest man of science of modern times, Mr. Darwin, whose books are, apart from their scientific value, quite delightful in their literary style. No one, for instance, could read his "Voyage in the *Beagle*" without seeing that Darwin's love of science was only a part of his love of nature. There is, indeed, no conflict between the two, and a man cannot strengthen the one side of his nature without at the same time contributing to strengthen the other. Indeed, the reason why so many of our living poets are inferior to those who wrote at the beginning of this century, or to those of an earlier generation still, is just that they have not had the pluck to look science in the face, but have only taken a passing and sideway glance at it.

"An important point in the argument—namely, the relation of science to morality—was suggested by the remarks that had been made on the subject of vivisection. The vivisection question, in the first place, did not seem to him to be quite fairly stated. People speak as though vivisection were a recent practice just introduced by a hard-hearted scientific generation. But in point of fact vivisection had been going on for many centuries. The thing which was new was the objection to it. The stock argument in favour of vivisection—that by it the discovery of the circulation of the blood was made—is only one of many instances.

"It had been remarked by a previous speaker, with whom he was inclined to agree, that there had been a great increase in humanity in modern times, and that this increase is to be attributed to the growth of science. It is not true, for instance, to say that the abolition of excessive and cruel punishments has been due to the action of a few energetic but unscientific individuals. They were, on the contrary, put down by the growth of the scientific spirit of the age—a spirit closely allied to humanity, and which showed itself in the philosophy of the eighteenth century, especially in the writings of Hume and Bentham. They gave up the idea of punishment as simply a revenge to gratify the feelings of the punishers, and took the Utilitarian ground, that it must only be administered in so far as it is beneficial to society. They were thus inevitably drawn into denouncing excessive punishments. Romilly, who

* Remarks by Mr. Leslie Stephen in summing up a debate at University College, London, on the motion by Mr. B. Paul Newman: "That the spread of scientific thought and method has, on the whole, exercised an injurious influence on English society." The motion was supported by Mr. N. Mickleman, and opposed by the Rev. A. Capes Tarbolton and Mr. J. G. Pease.

had been cited by the other side, was probably a pupil of that school; and certainly Bentham and Mill were, who really spread the principles which led to the abolition of excessive punishment. And those principles were only the principles of science applied to morality.

"Though he admired our ancestors of the sixteenth century, he felt bound to admit that they were a brutal lot. An instance of how far we have improved in point of humanity is to be seen in Roderick Random. After having reduced his young, amiable, and beloved hero to very great straits through "dissipation," Smollett makes him go to India to purchase a lot of slaves, whom he sells in America at a large profit. This we should consider brutal and degrading conduct, and the fact that we do so consider it marks the great improvement which has taken place in our morality. It is quite true that it is not merely the growth of science, but the general intellectual development of the country which has put a stop to cruelty; but it is equally true that the growth of science is an integral part of that development, and one that cannot be separated from it. None of these things would have been possible unless the intellect had widened; and science has helped to do this. We may hope for similar good results from the application of science to other things; for example, to politics, where there is little enough of scientific principles at present.

"On the religious question I can only say this," Mr. Stephen remarked in conclusion, "that you have got this plain dilemma to face, which cannot be avoided. In the first place, if any religion, or religious belief, is true, what can the holders of it have to fear from the growth of truth, which you call scientific truth? If these beliefs are destroyed, is it not a conclusive proof that they may be false, or at least contain an element of untruth? The religion may, indeed, have been very useful, although not true, and not qualified to satisfy all the aspirations of a cultivated mind. You may see, when a civilised race comes in contact with a lower race, that the effect of the sudden contact may be to destroy the religion and the rule of life of the inferior race, without putting anything it its place. Evils of that kind have been caused by modern science." It is destroying inevitably many beliefs which people have lived under well and happily. It is undeniable that this causes pain, and that it may be injurious to their morality I shall not attempt to deny. But when I am asked to say that therefore science is injurious, I have to come back to my original proposition—the remedy is more science. The only way out of the difficulty is this: We are here, and we have got to go—forward. And the only way is to apply the test of truth to all our beliefs. This effects a certain amount of pain, as every other kind of progress does; but the only other way is to go on believing what you know to be lies. And, without saying which are true and which are false, I cannot see how any person can wish to do anything else but increase the amount of truth, the only satisfactory cure."

Paper Cross-Ties.—A railway cross-tie has, says *Engineering*, been invented in America, made of paper or any other fibrous substance, such as straw or grass. This is reduced to a pulp, and run out into boards. Sheets or layers of this straw-board are laid one upon the other, cemented and pressed into moulds to form the cross-tie, which is practically fire and water proof, having been manufactured under a temperature of 500 deg. It is claimed that atmospheric changes have no effect upon it, that it can be made as cheaply as a wooden one, and will outlive five. It does not rot, and it deadens sound, which would be an advantage upon elevated railroads.

THE BRUSH DYNAMO-ELECTRIC MACHINE.

(*Concluded*).

In the previous article on the Brush dynamo it was stated that its chief feature is its armature, which, in so far as it consists of a ring of iron, with projecting teeth between the coils, resembles the Pacinotti ring. It has comparisons also with the Gramme ring; but the exceptional feature in it is the method of connecting the coils. In the Gramme, and all the long list of closely-allied machines, each coil of wire is connected to the next succeeding coil. In the Brush, however, no two contiguous coils are so joined, each coil being permanently connected by one of its extremities to the coil opposite it. This arrangement is shown roughly in Fig. 5, where R R is the iron ring, and S the shaft. The free ends of the coils are all connected to the commutator. Fig. 6, a diagram introduced by Prof. Thompson, in his paper before the Society of Arts, will help us materially in comprehending the general principles upon which the generation of the current depends. By referring to Fig. 1 (Knowledge, No. 81) it will be seen that (as pointed out in the article) there are two pairs of brushes, pressing on four commutator rings (Fig. 3), which are represented in Fig. 6 by A A′, B B′. The coils permanently connected are (in Fig. 6) similarly numbered, as 1,1, 2,2, &c. S and N represent the field-magnets, the arrows indicating the direction of the current.

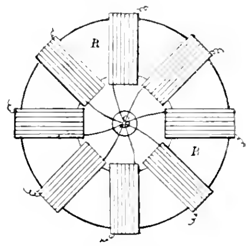
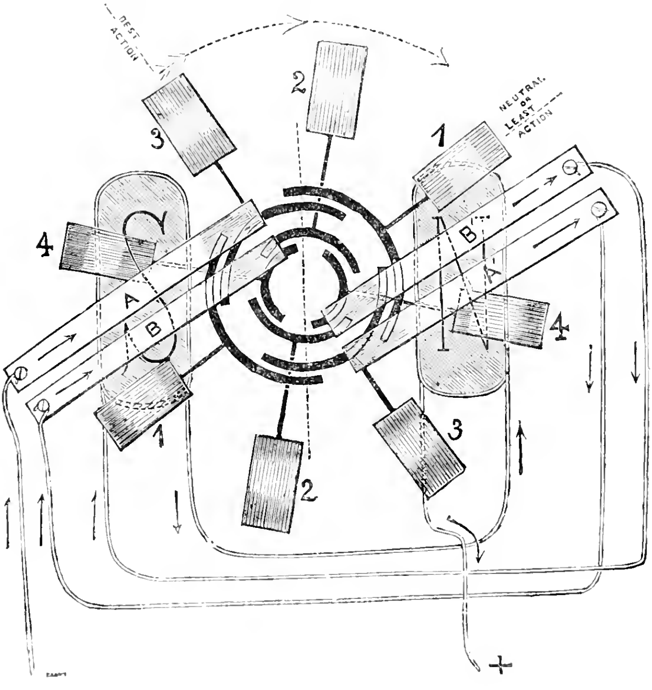


Fig. 5.

As the armature revolves, each pair of coils passes through the magnetic field, and is subjected, successively and oppositely, to every stage of the inductive influence—that is to say (associating ourselves with the coils 1,1), both coils are simultaneously in the neutral zone, or the region of minimum induction, this zone being at right angles to the direction of the lines of magnetic force. In this position, one of the brushes of the commutator presses the insulating piece (C, Fig. 3), and accordingly the circuit through coils 1,1 is disconnected. The object achieved in this arrangement is of a twofold nature. In the first place, the absence of a current in the coils during the period of disconnection allows time for the coils to get cool—an object which is also assisted by the grooved form of the iron ring, currents of air being allowed to pass through these grooves to carry off a large quantity of heat. It must not be forgotten that the resistance of a metallic conductor increases with the temperature, so that there are electrical as well as mechanical objections to a heated machine. In the second place, the coils being in the neutral zone, no useful current is being produced, and if the current produced in the other coils is allowed to pass through them, not only do they perform no good office, but they become a positive obstacle to the production of a

current of the highest efficiency by virtue of the electrical resistance offered by them.

In recently-constructed machines, an insulating block similar to C is fixed on the opposite side of the commutator ring. This addition does not increase the duration of the disconnection, which, as each block, C, measuring one-eighth of the ring's circumference, passes under the brushes twice in each revolution, amounts in the aggregate to 25 per cent. of the time the machine is running. The object attained by the adoption of two insulating blocks is to prevent a "static" charge in the coils, and so to materially reduce the sparking, which in the Brush machine is mainly due to static effects. Reverting to Fig. 6, coils 1, 1 pass next to the positions 4, 4, one going through the north field and the other through the south field. The coils for the current to split at B, part going through 2, 2, and part through 4, 4, reuniting at the brush B′. Thence the current passes through the field magnets in the direction indicated by the arrows, and, exciting them, emerges finally at +, which becomes the positive pole of the machine, the external current being connected to − and +. In Fig. 4 (KNOWLEDGE, No. 81) the current is shown to enter the field magnets after leaving the brush A′ and before entering the brush B, in which case B′ becomes the positive pole. It is clear that "the four pairs of coils constitute in reality four separate machines, each delivering alternate currents to a commutator, which commutes them to intermittent uni-directional currents in the brushes; and that these independent machines are ingeniously united in pairs by the



thus approach the zone of greatest action, 3, 3, simultaneously, but in opposite phases. Similarly, as they pass the position 2, 2, they both recede from the maximum and approach the minimum zone simultaneously and in opposite phases.

Regarding the armature at a moment when the various coils are in the position indicated in Fig. 6, the coils 3, 3 are in the region of maximum action, one coil being connected to the brush A, which becomes the negative pole of the machine, the other coil at the same time communicating its positive charge to the brush A′, and thence by wire to the brush B. The coils 2, 2 have left the position of best action, and the coils 4, 4 are at the same time approaching that position. The induction in each case is only partial, and, accordingly, an arrangement is made device of letting one pair of brushes press against the commutators of two pairs of coils. Further, that these paired machines are then connected in series by bringing a connection round from brush A′ to brush B." The Brush dynamo thus involves some of the prettiest ideas hitherto conceived; and multitudinous as has been the number of recently-born rivals, it remains the best where a large number of lamps are required to be worked in series. With the 40-light machine the objection to an electro-motive force of 2,000 volts in the conductors is, of course, a great one. So, also, is the objection to enormous gas-mains, as many living in the region of Tottenham Court-road a year or two since have cause to remember. Where, therefore, such immense currents are employed, it is imperative that the engineering should be

of the best, and that a pennywise policy should never be resorted to. From what has been recently going the rounds, it is to be feared that too little attention is being given to these latter requirements, and that the value of *employés* is estimated more by their servility and energy in "touching their hats to their superiors" than by their capacity for useful and remunerative work.

Overhead Wires in the United States.—Great opposition is being made, especially in Chicago, to the practice of the telephone and telegraph companies of carrying wires close to or over the roofs of houses, without the consent of the owners, or any compensation paid to them. In consequence of several adverse decisions, the companies in some places propose to stop communications.

Consul Berthold, of Breslau, had a free pass given him as a director of the Breslau, Schweidnitz, and Freiburg Railroad. He used it to secure free transportation for a part of the baggage of his wife and daughter when going to Marienbad. For this he was arrested and tried by a criminal court, charged with illegally obtaining a service worth 1·38 dols. He was found guilty, and sentenced to imprisonment for one week. He appealed, but in the higher court, his sentence was confirmed. What, says the *Railroad Gazette*, if this were thus in America?

In Switzerland in 1881 the average distance run per locomotive was 16,039; on the German railroads it was 17,185; and on the Austro-Hungarian roads 16,010 miles. In this country by the last census it was 22,355 miles. Here, therefore, 100 locomotives do as much work as 131 in Germany, 139 in Switzerland, and 140 in Austro-Hungary.—*Engineer.*

How a Locomotive was Raised from a River.—The *Elevated Railroad Journal* relates how the feat of raising a huge freight engine from the mud in Bush River, on the Philadelphia, Wilmington, and Baltimore Railroad, below Havre de Grace, was successfully accomplished a few days ago. The engine fell through the drawbridge some time ago. The difficulties of the feat may be imagined when it is understood that the engine was several feet below the water's surface, and completely buried in the mud. The wreckers have been at work a week, the first thing accomplished being the placing of heavy chains beneath the great mass of iron. Two divers, sent down for the purpose, were compelled to dig several feet under the soft mud at the bottom of the river. The chains were made taut to four heavy scows, which were filled with water at low tide. Everything being satisfactory, the water was pumped out of the scows, thus tightening the chains about the engine. When the tide began to rise, the engine was pulled a few feet from the mud. Then other scows were brought, and when the tide was again low, water was pumped in and the chains fastened to them. The tide went up again, and so did the engine, which came to the surface. After this had been repeated a number of times, the engine was swinging clear of the water, and was then placed on a large float, only slightly damaged, and wanting but few repairs to make it as good as before its tumble into the river. The railroad will now take charge of its fished-up property, and tow it to the river bank near the railroad track. To that point, when the tide is high, a temporary track will be built connecting with the railroad, and when the tide has fallen sufficiently to place the wheels of the engine on a level with the temporary structure, the engine will then be run on the wharf and to the main track. It will be taken to Wilmington and repaired; it cost 1,000 dols. to fish the engine out.

FIGURE CONJURING.

By Richard A. Proctor.

The figure conjurings given by several correspondents seem to me imperfect, because *before* the conjuror has abstracted the numbers really added during his mystifying processes, the number attained shows three out of the four digits in their original order. For instance, in the process on p. 395, the numbers 5, 4, 3, 2 were written down, and the number finally attained by the conjuror's victim is 543,520. I would propose some such arrangement as the following:—Take the four digits in their order, multiply by 2, add 2,460, multiply by 5, add 45, multiply by 10; then subtract (privately) 123,450. Thus, let the numbers be 5, 4, 3, and 2. The process, then, is as follows:—

	5,432
multiply by	2
	10,864
add	2,460
	13,324
multiply by	5
	66,620
add	45
	66,665
multiply by	10
	666,650
subtract	123,450
giving the number	5432 00

Where the trick has to be performed several times the arrangement can easily be varied, especially as regards the sum added at the second step and subtracted at the last. It is convenient to let all the digits of this number be even. Note also that the second digit of the second number added is of no account; it is only added to help the mystification, by avoiding two cyphers at the close of the operations followed by the performer openly. If these rules be followed, the number to be secretly subtracted is always given by halving the three first digits of first addend and appending the first digit of the second. Thus, let the first be 4,280 and the second 37; then the number to be subtracted (or the only part of that number worth considering), will be 2,143 (half of 428 with 3 appended). Take, for instance, the digits 7, 1, 9, 3; then the process will be:—

	7,193
×	2
	14,386
+	4,280
	18,666
×	5
	93,330
+	37
	93,367
×	10
	93,36 70
subtract	2,143
	7,193 as required.

The multiplication by 10, by the way, is quite unnecessary.

Editorial Gossip.

Captain Webb is to swim the Lower Rapids of Niagara, for the benefit of himself first—should he survive the experiment—and of the American railway companies in any event. We should be sorry to limit in any way Captain Webb's legitimate right to do what he likes with his own. But unfortunately his plan involves more than this. He is setting a most demoralising example. The railway companies are bartering a life against money, and the rascality of their course is so obvious as to need no comment. But many will feel sympathy with Captain Webb instead of that contempt which should be felt for the man who, being well able to earn an honest living in more ways than one, prefers to stake his life for a sum large enough to keep him for several years, as a reward for a few hours' struggle with death.

It is time that the nonsense ventilated about Zukertort and his defeat by Sellman and Mortimer should be answered. We are told of the exhaustion following his protracted struggle, of his wilfully giving up the games, and so forth. Any one who plays through the two games will see that Zukertort, having no special reason for wanting to win these two games, was content to play rather for effect than on those strictly sound principles which can alone ensure success in match games. There is not the slightest trace of weakness in his game with Mortimer, the weakest of his opponents; but there is marked evidence of rashness, or rather, of what would have been rashness if success in the tourney had depended on success in this particular game. Men are not apt when exhausted to go in for undue daring.

Dr. Hastings, finding line 1,474 longer on that side of the corona most exposed, both before and after totality, starts the theory that the outer parts of the corona are merely phenomena of diffraction. The observation really shows that the matter giving this line does not extend into or near the outer parts of the corona. We shall have Mr. Lockyer going back to his first love, the atmospheric glare corona, illustrated by the cork-in-a-shutter experiment, in which the sun is the sun, the cork the moon, and the shutter is—nothing in particular.

The simple facts that every solar appendage which is not hidden by the moon illuminates our air even at the time of totality, while any illumination so caused must increase with distance from the solar disc, accord perfectly with Dr. Hastings' observation, as with all others yet made, without the absurdity to which he is said to have committed himself,—at which I imagine those among his fellow-workers in America who are competent to form an opinion, as Professors Young, Newcomb, and Langley, will be disposed to smile.

In Knowledge for April 6 we chanced to remark of the *Sidereal Messenger* for December, 1882, that it contained chiefly borrowed articles and editorial notes. "'Chiefly borrowed articles!'" says the *Messenger* for June; "Knowledge ought to know that such a statement is grossly untrue." If we have offended against truth, even this "lie direct" is deserved; and whether it is or not deserved, it shall not provoke the "countercheck quarrelsome." The *Sidereal Messenger*, conducted by Professor W. W. Payne, Director of Carleton College Observatory, is a very useful publication, and of the June number it certainly cannot be said that it contains chiefly borrowed articles. There is an admirable article on the "Effect of Flexure on the Axis of Transit Instruments with the (so-called) Broken Telescope," by Professor C. A. Young, Princeton, N.J.; one article only borrowed (from the proceedings of the Appalachian Club), on "Mountain Observatories," by Prof. E. C. Pickering; an article by the editor on "The Comet of 1882"; one by Mr. Louis Swift on "Intra-Mercurial Planets"; and two other original articles. As to the December number, we do not repeat our statement that it consisted chiefly of borrowed articles and editorial notes, because that would seem like giving our esteemed Transatlantic contemporary the lie direct, and that would not be courteous. We simply note that besides editorial notes and borrowed articles, it contained two original articles, one on "the Computation of a Parabolic Orbit," and one on the "Great Comet of 1882,"—"only these, and nothing more."

We further expressed our opinion that our own very early discussion of the orbit of the great comet of 1882, in which we expressly referred to the possibility that the Vienna observation of September 24, on which the discussion was practically based, might be incorrect, ought not to have been reprinted in December, when it was known that that observation was utterly incorrect, without some remark to that effect. The editor of the *Messenger*, instead of expressing regret for what was a manifest injustice to us, though doubtless only by inadvertence, dwells now on our unique haste and bold guessing. There was no haste and no bold guessing, but simply what we take to have been an instructive computation (the *Messenger* admits that it involved a simple and neat application of cycloidal geometry), every line of which was correct, and the result, with the proviso indicated plainly in the body of the article, correct also. We repeat now what we said then, that were the observation at Vienna on September 24 correct, the period of the comet would have been as short as we stated.

The *Spectator* charges Miss Peard, in "Contradictions," with betraying ignorance of cricket, because she describes a player as "caught at slip from a skyer," which he considers next door to an absolute impossibility. Mr. H. Katenkamp, joining issue, says that, on the contrary, of all the fates that await an uncertain batsman, none, especially in the long slip, is more common. To which the *Spectator* makes rejoinder that a "skyer" is a ball hit or driven with the batsman's full force, but with the left shoulder not sufficiently forward; and that "a very late hit to leg might just conceivably send a skyer to the slips." Surely this is absurd. A "skyer" is a ball which flies skywards, whether from a drive, a hit to leg, or a cut. A misjudged late cut at a ball with plenty of spin on is as apt to send a skyer to the slips as any stroke a cricketer can make; but a "skyer" to the slips from a late hit to leg is next to an impossibility, and how such a stroke could be regarded as made with the left shoulder in any degree forward, it would puzzle W. G. himself to imagine. Let any one try to hit a leg ball to the slips with his left shoulder forward, and he will learn that there are twisters other than twisting balls.

The produce of labour has, we read, been divided between capital and labour as follows in the countries named:—Assuming the produce of labour to be 100 in Great Britain, 56 parts go to the labourer, 21 to capital, and 23 to the Government. In France, 47 parts go to labour, 36 to capital, and 17 to the Government. In the United States, 72 parts go to labour, 23 to capital, and 5 to the Government.

THE DIVIDED SKIRT.

IN the first number of KNOWLEDGE I gave an amusing article from the *New York Times* about pyramid theories. It was written presumably by Mr. Alden, whose occasional serio-comic articles are a most attractive feature of that leading New York paper. I suppose we owe to the same clever pen an article recently quoted in the *Standard* about a habit chaffingly attributed to the Missourian belles, who, according to this view, might be described as snapping turtle[dove]s. (Four Missourian ladies happened to be present in my house when that article appeared, but observation has hitherto failed to confirm the statements of the *New York Times* in their case, and I can only assume that the habit of biting is not universal among the fair Missourians.) I think readers of KNOWLEDGE will read with amusement the following specimen of Mr. Alden's quaint humour:—

"Mr. Richard A. Proctor, the distinguished astronomer, has recently made some new investigations as to certain heavenly bodies which show him to be a man of great fearlessness and originality.

"According to Mr. Proctor's own statement, set forth in a letter addressed to the London *Times*, he has of late ceased his explanations of the milky way and concentrated all his powers of observation upon corsets and skirts. Of course, his scientific attainments have given him exceptional facilities for exploration in his new field. Knowing the diameter of any given skirt, he is able to calculate its contents, and if the elements of a corset are given to him he can ascertain to the millionth part of an inch the length of arm required to encircle it, and the cubic feet of girl which it contains. Conversely, with a knowledge of the radius of any given girl, he can find the size of both the skirt and corset best adapted to her. There is no haphazard guesswork in Mr. Proctor's investigations of feminine dress. He proceeds by strictly scientific methods, and he grasps figures with an assurance and success which no unscientific person could hope to rival.

"Several interesting experiments have been made by Mr. Proctor upon 'subjects' styled by him the 'ladies of my family.' These experiments began with the removal of corsets. It was found that great advantages at once followed this measure. For example, the voice 'increased markedly both in power and compass,' so that when Mrs. Proctor now remarks to Mr. Proctor, from the top of the stairs at midnight, 'Richard, you've been sitting up with those horrid stars again,' she can be heard by neighbours living at a distance of an eighth of a mile, whereas her voice could formerly be heard only half that distance.

"At the same time Mr. Proctor found that the withdrawal of corsets left the skirts of the subjects insufficiently supported. He therefore substituted 'divided skirts' for those of the usual pattern, and thus obviated the difficulty. With the 'divided skirt,' lawn-tennis, tricycling, and other open-air exercises became much easier, and Mr. Proctor is so completely satisfied with the result which he has attained that he is now longing to deprive all his countrywomen of corsets and to put them into the 'divided skirt.'

"From the tone of his letter, it is plain that the astronomer is more enthusiastic as to the clothing of the women of England than he has even been as to the stars. The transit of a young lady clothed in a 'divided' skirt over a stone wall is watched by him with as much interest as if he were observing a transit of Venus across the sun, and the orbit of a tricycle rider with a divided skirt presents elements more interesting than those of the orbit of any comet. In all probability Mr. Proctor will henceforth throw aside his telescope, and devote himself exclusively to observations made through an opera-glass.

"It may be quite possible that all the advantages claimed for the 'divided skirt' by Mr. Proctor may exist, but whether they would compensate for the ugliness of the garment is a question which most women, and all men with minds uncontaminated by astronomy, will unhesitatingly answer in the negative" [only as no eye, not even the keenest astronomical eye, armed with a telescope of "ten million gas magnifying power" can recognise any change at all, this particular objection scarcely counts.—R. P.].

SOMETHING ABOUT THE BEET.

AS the editor kindly allowed me to put before the readers of KNOWLEDGE a few facts ascertained by chemists with respect to the potato, I am in this going to try if I cannot give some interesting, and at the same time scientific, facts with reference to the beet. In 1880 alone, there were no less than *forty-three* important communications to the scientific world, announcing the results of various investigations carried on in connection with this plant. And it is through this that I think it a duty for some person or other to lay before the public some, at least, of the interesting and useful parts of their (the chemists') investigations. What do most of us know about the beet, beyond the fact that we plant it in our gardens, and in due time eat it, either as pickle or plainly boiled, or prepared like cucumber, or used for salads? I take it for granted that we all, at the same time, know all about the manufacture of this plant for sugar, also its history, and how chemistry in those early days came to the rescue of the manufacturer, so that he might be able to manufacture a sugar in his own country (Germany and France), instead of importing the colonial cane-sugar; how the duties were raised on foreign sugars to make it prohibitory to import them, as it raised the price to a fabulous sum per pound, I forget now how much, and should not like to guess, for fear of underrating the amount; but these and other interesting matters will be found in the "Chemistry of Common Life," by Johnson and Church, by those who have not read the account of it. But it is not my intention to go back to the old ground, but to bring forward later information.

In my communication about potatoes, I showed you what an influence light had on the sprouting of tubers; we shall now see that light has also a very marked effect on beet. Beet, when grown in the shade, runs more to seed, and does not ripen as soon as when it is grown in the open; and to make this more clear, I will give two results obtained by two different chemists to bear out the assertion.

In one case the relation—in the shade—between the leaves and root was 66·34, and in the open the relations were nearly exactly reversed, viz., 35·66. The same chemist found that 1,000 plants in the open yielded 32·5 kilos sugar, while the same number in the shade only yielded 13·4 kilos (a kilo = about 2 lb. 3 oz.).

The other chemist planted a lot of willows, and between the willows he planted his beets with the following results:—The beets he grew in the open yielded 11·14 per cent. of sugar, 350 grammes of root to 100 of leaf, and the beet grown amongst the willows yielded only 8·8 per cent. of sugar, and only 40·3 grammes of root to 100 of leaf (a gramme is not quite 15½ grains).

This shows us how important it is to set our plants in the open, and the same also applies to the potato, for the two plants are very similar in their wants, as we shall see.

We now come to the effect of heat on the growing beet, and we find that a mean temperature of from 14° to 18° C., from May to October inclusive, and a warm and wet spring, together with a not too dry summer, are the best conditions under which beet can be grown. Heat has the same beneficial effect on the beet as on the potato. Beets require a total temperature of 117° C. before they make their appearance above ground, and as beets require to reach perfection in as short a time as possible for successful extraction of the sugar, it is easily seen that too early planting is disadvantageous to the growth and manufacture. Beet thrives best in those countries where a hot summer is followed by a very cold winter (⅗ of the number of degrees Centigrade + 32 = the degrees Fahrenheit, *i.e.*, English temperature). When you cut open a beet you see two concentric rings, the one white and opaque, the other clear, transparent, and mostly coloured; the former contains the chief part of the sugar, while the latter contains the albumen.

Ploughing has a very favourable influence on the quantity of the crop, if the ploughing is deep, and is next in importance to planting,

which we shall see is one of the chief causes of success in beet cultivation. If the manures are ploughed in, the roots form regularly, only about 35 per cent. having irregularities, side roots, &c., whereas in the other case, *i.e.*, if the manure is not ploughed in, the percentage is about 60 per cent.

In thick sowing, the produce of the beet crop is smaller in quantity, but of higher value, on account of the sugar, and in the density and purity of the juice, than in thin sowing. According to the space allotted to each plant, the yield of sugar varied, in one case, from 86 to 91 per cent., and in another case from 88 to 93 per cent. This important fact is more to be considered than the manuring or the kind of beet grown. The distance between the plants should be small on a humid and matured land, but great on a dry, high ground and poor soil.

A better produce is obtained from a sandy soil than from a peat soil. Experiments give for the former 10·46 and 13·90 per cent. of sugar, and for the latter 8·35 and 8·39 per cent. as the yield.

The leaves of the beet have had a good deal of attention given them by the chemist.

Cows fed on the leaves of beet yield more milk a day than when pasture fed, though the milk is lower in total solids and fat; but not only is the yield of milk more through the use of the leaf, but the food is, at the same time, more nourishing to the animal. I will give you one of the results of experiments made to confirm this:—

	Kilos.
After feeding on leaves, weight	485
Before " " "	450
Increase.	35 kilos.

So we see that there was a gain of at least 82 lb. through feeding the animal with this food.

It is not, at the same time, advisable to feed them entirely on this. The leaves should be preserved in pits, according to the well-known plan, and covered with earth about a foot deep; then, when required for use, given with a mixed diet, containing a large amount of the leaves. It will be found that this is the best kind of fattening fodder for sheep and cattle. The leaves of the beet contain small quantities of glucose, and those roots which have well developed their leaves are the richest in sugar.

The fresh leaves contain about 4 per cent. of oxalic acid, about a third of which exists in a soluble form. It will now be seen why I said it was not advisable to feed cattle entirely on the fresh leaves, as the acid induces inflammation of the mucous membrane of the stomach. Pickling the leaves with chalk will, in all probability, prevent this, as the soluble acid would be converted into calcium oxalate, which is insoluble in the stomach. Leaves of the beet change through keeping; in fact, no other cattle food loses so much by storing as these leaves. The mineral constituents suffer the most, especially potash-magnesia. Phosphoric and silicic acid and chlorine—the soluble oxalates—are also removed, for they are reduced from 1·14 to ·55 per cent. This shows why it is of so much advantage to preserve the leaves, and accounts for the well-known fact that beet leaves are comparatively harmless after having been allowed to decay. Aconite may be extracted from beet leaves, as well as other organic substances.

The residue left by the diffused method of extracting the juice is of much greater value for cattle fodder than that obtained by the hydraulic or maceration processes. We now come to a matter on which some chemists differ—I mean in the relation of phosphoric acid in root and leaves to the sugar in beet. I will give three different results deduced by separate chemists, and leave your readers to judge for themselves if there is, or is not, a relation between the two. These are the results:—

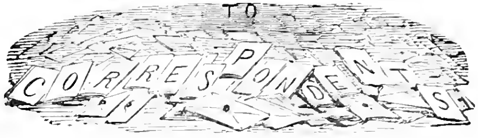
1. There is a certain constancy in the proportion existing between the amount of sugar in beet and the amount of phosphoric acid in the root and leaves, and between the sugar and the ash. Experiments gave the proportion of the former 100 : 1·2 and 100 : 1·15; and the proportion between sugar in beet and ash (root and leaves), 100 : 18·3.

2. Gave for the proportion 100 : 1·15, and says that the relation is constant. It will be seen that his results coincide with Number 1. The higher the yield of sugar the less the soil is impoverished, we are informed.

3. Made experiments to prove that there is a relation between the potash absorbed in the root to the sugar produced. He says this is constant; viz.—about 100 : 2; but he could not observe any constant relation between the phosphoric acid and the sugar.

After seeing these three reports, we see that there is some doubt about the matter, which will, we hope, soon be cleared up. It certainly looks as if there was a certain constant relation, when two chemists, working separately, coincide in their results; but we cannot be satisfied until every doubt is removed.

(To be continued.)



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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LARGE SUN-SPOT.

[866]—Once more, and for the fourth time within the last eight months, there is a spot on the sun so large as to be visible to the unaided eye.

In observing the sun with my telescope on Wednesday and Thursday last, I saw, besides many other smaller ones, one very pretty group of fair-sized spots. After Thursday, I had not an opportunity of observing the sun with the telescope until yesterday, and I then found that in the meantime one of the spots of this group had grown into a very large one, and on procuring a piece of ordinary smoked glass to look through, I could see the spot distinctly with unaided eyes, it being situated a little north of the sun's centre, and I have again seen it in the same way this morning.

Seen in the telescope, it is a remarkably pretty spot, the central black part, or umbra, being oblong in shape and crossed in several directions by the white streaks called bridges. Just to the east of this spot, and apparently almost touching it, is another good-sized one, very long and narrow in shape; and in close proximity to these two are several much smaller ones, altogether forming a very pretty group. And then, in addition to all these, there are many other small ones scattered about the sun's face, principally near the western edge, so that just now the sun is a pretty sight to any one possessing the means of scrutinising it. EXCELSIOR.

Huddersfield, *July* 2, 1883.

ANSWER TO GENEALOGICAL PUZZLE IN OUR LAST.

[867]—X marries M, and has a son, A. His wife dies (say in 1820), and, in 1822, he marries again, N; and has a son, Tom. X dies in 1824, and his widow, N, marries Z, and they have a son, B.

Or—

```
M x X x N x Z
  |   |   |
  A  Tom  B
```

865, page 13. Solution:—

A's father dies.
A's mother marries again, and Tom is born.
A's mother dies.
Tom is brother to A.
Tom's father marries again, and B is born.
Tom is brother to B.
A and B are in no consanguinous way related.

[There are several ways in which the puzzle may be solved. Query, How many?—R. P.]

RATIONAL DRESS FOR MEN.

[868]—I think "Mr. G. C. Mesnard," in writing in favour of braces over the belt, may not know how the belt should be made or worn. I have worn my belt for six years. It was made for me by my tailor, Mr. Davies, of South Molton-street, Bond-street; it is 3 in. wide, *made of morocco leather*, has a *ring over each hip*, and a special buckle. The rings and buckles in my case are silver, as I could not get the buckle otherwise. It should be worn as low over

the bowels as possible, and kept there by means of loops. This is essential to comfort.

An old sinner I once knew, who had kept his figure well, wore a wide linen belt inside his trousers, fastened at the hips. For heavy trousers I wear a wide belt (material unknown) fastened at the hips and buckled behind. I think "A Woman" will find that trousers are cooler than knickerbockers, as socks can be worn; they also protect the ankles, and prevent dirt getting into the shoes. After much trial I do all manual labour in knickerbockers, but far prefer trousers for walking in. Still, I think knickerbockers would be far more comfortable for ladies; there is a sense of freedom in them. John Alex. Ollard, Enfield.

DRESS REFORM.

[869]—Having read most of the letters and articles on "Dress Reform" appearing in Knowledge, might I inquire, if sufficiently relevant to the subject, of some of our readers who know what the reason or advantage is in wearing the "scarf" round the waist, as worn by Frenchmen, Spaniards, Italians, &c., some of which scarves are very large (1 ft. broad by 12 ft. long)? If this is necessary as part of their dress, it certainly seems ungainly (as 3 or 4 inches of trousers), though it may be rational. Faja.

[870]—I am sorry I did not describe the divided skirt: there has been so much said about it, that I imagined this was unnecessary. It takes from 4 to $4\frac{1}{2}$ yards of ordinary skirting, and is in two legs, like a large pair of woman's drawers. For any one of medium height, the dimensions of the skirt proper would be as follow:—Entire length (front) 31 in., (back) 1 yd.; length of leg on inside seam 24 in.; circumference of leg at ankle 22 in., at widest part, 35 in. Each leg is trimmed with two kiltings; the little one round the bottom is 2 in. in depth, the other 11 in.

The top of the skirt is gathered into an inch band, one yard long; this band has button-holes in it, corresponding to buttons on the belt. The belt is the most difficult thing to describe, and I doubt if I can do it intelligibly. It fits the hip closely; the depth in front is 7 in., at the back (where it fastens) it is $4\frac{1}{2}$. The foundation is of some stiff material, and has four gores in front. These are 3 in. wide at the top and $4\frac{1}{2}$ at the bottom, but I am very small over the hips. A dressmaker would fit the belt best. The buttons I have mentioned can be anywhere on the belt, mine are round the middle.

I would recommend ladies living in the country not to have the skirt too long, as it catches the mud.

These measurements are carefully taken from a pattern sent me by the original society. I shall be glad to give anyone more particulars if these are not sufficient. Pedestrienne.

ALTERATION IN COAST-LINE, &c.

[871]—Professor Geikie was my authority for saying the sea was gaining on the land on some parts of the east coast of England at the rate of about three feet a century; but I did not say in my letter (768) that the Sheppey cliffs were going at this rate.

From personal observations, I knew the action on the island was very rapid; in fact, I should say it was much greater than your correspondent (820) states.

As regards the submerged forest, my information was obtained some considerable time since from a scientific magazine, the name of which I forget; but I am quite willing to believe Mr. Shrubsole—who is an authority—that after all it was drift timber which had been discovered, and which led to the notion that a "submerged forest" had been found. Hewitt.

THE BELUGA IN THE BRIGHTON AQUARIUM.

[872]—A noble quadruped galloping through the water. Perhaps I ought to have written to Mr. Lockyer about galloping, but should much prefer your judgment, if obtainable.

The first sentence appears to me a correct description of the swimming movement of the dolphin, and at the same time a new view of the motion, or one that has not previously been remarked upon.

Professor Flower has shown (which I learned through Knowledge) that whales are derived from land quadrupeds, and this being admitted, it follows that their (the whales') progressive movements through the water are derived in the same way.

Thomas Kimber.

[It is singular that when I was watching the bottle-nosed dolphin at the Brighton Aquarium, from above (Mr. Lawler kindly accompanied me, and gave me much interesting information), the same idea occurred to me, as I observed the singular contrast between his way of using his tail and that in which a fish uses his. That movement of the tail and the resulting change in the position of the body—which one sees also in the movement of porpoises—is strongly suggestive of galloping, though, of course, the absence of hind legs somewhat impairs the idea.—R. P.]

TO SEE THE SURFACE OF THE EYES.

[873]—Having read the papers and letters on the eyes with much interest, I herewith give a method of seeing the surface of the eye which may be new and interesting.

Make a very small pin-hole through a piece of paper, and, holding the paper about an inch from the eye, look through at a light. If the hole is small enough the sun will do, but gas or candle-light gives the best results. A small spherical or other body which gives a very small but strong reflection will give the same results. I have had several "fires" on my eyeballs, and have found by this method that the marks have remained for a year or two, although they disappeared in two or three days to all outward appearance.

W. Melville.

LETTERS RECEIVED AND SHORT ANSWERS.

G. M. Many thanks. Mr. Clodd's earlier books (sold by tens of thousands) published by Macmillan. But I think the book you refer to, "Jesus of Nazareth," is published by Chatto & Windus. Being away from home (see lecture advertisements) cannot refer to my copy to see. Signalling at whist is playing an unnecessarily high card to a trick, as "five" when you hold "two;" the fall of the lower card in the next round completes the signal.—C. W. Harding. Do not keep account of such matters. Writers send me their names and addresses in guarantee of good faith, but my memory does not retain them all.—E. H. Stutter. The word *Times*, No. 87, p. 384, was written without any apostrophe at all, the apostrophe being added by the printers of the *Newcastle Weekly Chronicle*. I meant it as written, just as one might speak of a *Punch* article, or an *Echo* remark. One would certainly not speak of the *Times'* views, but of the *Times's* views; but as you say, where the "es" at the end of a word is sounded, then — and then only — the apostrophe alone should be used, as Moses' laws, Archimedes' theory, and so forth.—P. A. Fothergill. Have not time to look up Mr. Hampden's remarks on evolution; but I agree with you that his being astray on one subject is no reason why he should be astray on all.—E. Luxmore. Thanks.—J. B. If I missed the first of your questions, it must be in not noticing that what you want me really to determine is the proper meaning of the word "level." I substituted the word "horizontal," in that sense in which it is equivalent to the word "level." If you want to know whether water poured on a perfectly plane table, a mile square and with its plane at the centre at right angles to the direction of gravity, would be deeper in the centre than at the sides, my answer tells you. If you ask whether such a table could *properly* be called "level," I answer "no." If you ask what would be meant by a level table a mile square, I answer that I don't know. Neither the scientific sense of the word "level," nor the ordinary sense, can properly be applied to a surface so large, whether plane or curved. In levelling, distances so short are dealt with that the curvature of the earth may be neglected; if distances much larger are dealt with, other words must be used.—J. S., S. S. L. If you want an exact answer, mine is correct. If you think "the curvature is practically *nil*," then you can leave it out of account. I'm sure I don't want to consider it. As a matter of fact, when a cannon ball is fired with a horizontal velocity of 2,000 feet per second, from a parapet 16 feet high, over smooth water, it travels (apart from atmospheric resistance) 2,000 feet before it has been drawn 16 feet earthwards; and since a point on its original course, but 2,000 feet from its starting-place, is 16 feet $1\frac{1}{2}$ inch above the water, the cannon-ball is still $1\frac{1}{2}$ inches above the water at the end of a second, when the one let fall from the same height has just reached the water. So much if you ask for information; but if your object in asking the question was eventually to remind me of the law that "change of motion is in the direction of the impressed force, and proportional to it," I can only say I am very much obliged to you: as I should be if you reminded me of one of the details of the multiplication table.—E. G. McG. Thanks; but quite unable to spare space for such notices.—L. McCall. I thank you warmly for the pains you have taken; but the subject is not one to be dealt with so fully in these columns. There are many who are offended at the very use of the word "faith" in that connection, just as they are offended by a common use of the word "loyalty" in a sense which seems to them at once degraded and degrading. I would not needlessly offend these, even if I did not agree with them. The question amounts for most to little more than this: a certain people (not too warmly beloved by

all) seem to have collected everything written by men of their race, as of superhuman excellence, and many outside the race accept that view; others do not: with the former such matters as your father dealt with are very properly regarded as "of faith"; with others they are not so regarded at all. These last take little interest in inquiries of the sort. It seems *to them* the merest accident that instead of them, such matters as the proper interpretation of the Homeric records have not come to be questions of faith. We must consider these, who are many—even among those who are supposed to view matters otherwise.—A. ANDREWS. I am sorry, but it is contrary to "our" rules to answer queries of the sort.—H. ASKEW. Any proof by which it is shown that the sum of the roots of an equation of the nth degree is equal to *minus* the co-efficient of x^{n-1}, will serve to show that the sum of the nth roots of unity, and the sum of their reciprocals, are each equal to zero.—H. C. JONES. Your society for correcting, detecting, and, where necessary, exposing slander, has my heartiest good wishes; but my time is so fully occupied that my joining it would be useless. Many thanks for your kind words and good wishes.—W. T. SOUTHWARD. "Most men" and "a large majority of your fellow-countrymen!" We question each point; but the two statements are very different. Albeit KNOWLEDGE is meant for those who take an interest in science, "Most men" and "the large majority of our fellow-countrymen" do not take the least interest in science. More are students of science now than were so twenty years ago; but they are not one in a hundred of the population yet. Can you imagine that in catering for these, I am likely to consider those others, even if most of them do hold, as you say they do, the ideas you mention? The only way in which those ideas can ever become matter of scientific inquiry is in the way in which they have been touched on here. Their origin, the way in which they have spread, have become modified, have died out among those who inquire, and so forth these are matters of scientific interest, because, among the subjects of inquiry which science takes up, all relating to man and his ways must be included. If you regard as sneering every expression implying views which do not happen to agree with your particular views, it is unfortunate; but the fault is not here. Of myself personally I may say (so far as I can judge myself), what I recognise as true of Messrs. Slack, Williams, Clodd, Grant Allen, Wilson, and others whose personality comes most clearly before the readers of KNOWLEDGE, that we are one and all exceptionally free from any concern or trouble of mind because others may not view matters precisely as we do. For instance, it appears you differ from me in some points on which you have touched. Very well. What can it matter? If what I say does not commend itself to you, it does *not*, and there an end. No sneer whatever is intended when I say that, while preferring my own views, I have no wish to controvert yours.—H. MALIM. No: the velocity in the original horizontal direction is affected by gravity, which only acts at right angles to that part of the motion at the beginning. See analytical solution.—E. P. TOY. I am much obliged to you; but travel about so much that fear the book might not be returned in due time. May I be permitted to mention here that your letter gives strong avouchment of the truth of the account of Mrs. Croad's thought-reading powers?—P. PERCIVAL. The statement has never, I believe, been challenged. It was discussed a few years ago before the Astronomical Society, but not questioned. Dr. Warren de la Rue brought it, if I remember rightly, before the notice of the society. But while, so far as I know, no one doubts or denies the occasional existence of organic matter in meteorites, what *has* been challenged and thoroughly controverted is the statement made a year or two ago, that the remains of lower types of vegetable and even animal life had been detected in meteorites.—C. J. B. Your question cannot be answered; the velocity of the foot varies from 0 through a maximum to 0, the average rate being 2 yds. (the actual distance covered by the moving foot in a so-called one-yard step) in 11-15ths of a second, the time during which one foot is moving and the other at rest.—A WEAK ONE. So hard to get space; but soon. G. M. Mr. Clodd's "Jesus of Nazareth" is published by Messrs. Kegan Paul & Co.—G. G. HARDINGHAM. It would not be very easy to answer your questions about star-drift in convenient space here. Maps showing the star-drift for all the stars whose proper motion has been determined appear in my "Universe of the Stars."

SUB-EDITORIAL.

J. S. W.—A. F. O.—J. HARRINGTON.—M. N. E.—A BLIND ONE. T. J. R.—PERPLEXED.—F. MACKAY. The Editor is not a medical man, nor am I.

ERRATA.—In the solution at pp. 10, 11, the following errata occur: P. 10, line 19 from bottom, for $\frac{1}{2}bc.abC$, read $\frac{1}{2}bc.bC$; p. 11, line 11, for "twice" read "half."

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART VII.

THE result obtained at p. 15, fitly introduces us to an important class of problems—viz., those in which we have to show that certain lines, areas, &c., are the greatest or least which can be constructed under certain assigned conditions. There are few problems of this sort in Euclid. In fact, the seventh and eighth propositions of the third book are the only theorems in Euclid expressly dealing with geometrical maxima and minima. But many interesting deductions involve such relations as we are speaking of, and it is well for the student to know how to deal with them.

It will be noticed that some of the problems already dealt with may be presented as examples of geometrical maxima and minima. For instance, Ex. 4 may be presented in the following form:—

Ex. 9.—*From a point within a quadrilateral lines are drawn to the angles of the quadrilateral; show that the sum of these lines will be a minimum when the point is at the intersection of the diagonals.*

Presented in this form the problem would be solved precisely as Ex. 4. But suppose it had been given in the following form:—

Determine a point within a quadrilateral such that the sum of the lines from the point to the angles of the quadrilateral shall be a minimum.

Here assuming the student to have no knowledge of the property established in Ex. 4, the problem is not quite so simple. Let us see how it is to be dealt with.

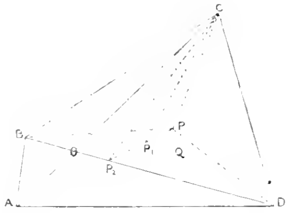

Fig. 14.

Draw first the quadrilateral, A B C D (Fig. 14), and from some assumed point, P, draw P A, P B, P C, and P D. Then we have to inquire how to shift P so as to lessen the sum of the distances, P A, P B, P C, P D.

A very short inquiry suffices to show that we shall not gain much information by considering the lines P A, P B, P C, and P D in adjacent pairs. The inquiry might run somewhat in this way: If P be brought towards B A, the sum of the lines P B, P A will diminish; but the sum of the lines P C and P D will increase. We have no obvious signs showing whether the diminution or increase be the greater. Therefore we are not tempted to continue this mode of inquiry.

Can we, then, by taking the lines in alternate pairs, diminish the sum of one pair without increasing the sum of the other? By bringing P towards the line B D (which we draw, at this point of the inquiry), the sum of the lines B P, P D, is diminished (Euc. I., 21). Now if this were done without any attention to the lines P C, P A—for instance, if P moved to Q—it would not be easy to assert that the sum of the *four* distances from the angles was diminishing. But if P be made to move along P A, as to P_1, then—since C P is less than P C and P P_1 together—we are diminishing, not merely the sum of the distances from B and D, but the sum of those from C and A. So long, then, as we continue this process, we cannot be going wrong. So that if we bring P to P_2—the intersection of P A and B D—we have diminished the sum of the distances as much as *this* process allows us to do. It is now obvious that by shifting our point from P_2 towards A C, along the line P_2 B, we are yet farther diminishing the sum of the distances, until we reach the intersection of P_2 B and A C (which are here drawn in). At this point of intersection, O, the second process has done all it can do for us. We see, also, that O is a fixed point within the quadrilateral, since it is the intersection of the diagonals. Also, P being *any* point, our process shows that wherever our point be taken, the sum of the distances diminishes continually as the point

is made—by the double process above described—to approach O. Thus we are quite certain that O is the required point. Instead, however, of proving this by going through the necessary steps of the above process—which *would* be a sufficient proof—the student should give the proof in the following form, obviously suggested by the process he had before followed :—

Draw the diagonals A C, B D meeting in O; then O is the required point. For, let P be any other point, and therefore not on *both* diagonals—say not on B D. Then B P and P D are greater than B D (Euc. I., 20), and A P and P C are not less than A C (greater than A C if P do not lie in A C); hence P A, P B, P C, and P D are together greater than O A, O B, O C, and O D together.

We have given the process determining the solution, in the form which would most probably suggest itself. The double process is also very instructive and suggestive. But the practised geometrician would probably notice at once that the approach of P towards O, *in a straight line*, diminishes at once the sum of P B, P D, and that of P A, P C. Hence we would argue—in presenting the proof —O *must* be the point we seek; for, let any other point give a minimum sum, then, by taking a point nearer O, we obtain a less sum—that is, said point does *not* give a minimum: which is absurd.

(*To be continued.*)

Our Chess Column.

By Mephisto.

USEFUL END GAME.

In a game between Blackburne and English in the late tournament, the former player effected a draw in an ingenious manner, although being at the time a Pawn behind.

ENGLISH.

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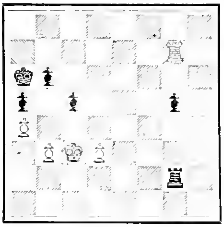


WHITE.

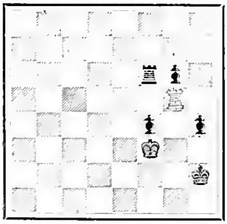
BLACKBURNE.

In this position Blackburne drew by playing

K to B4	R to B7 (ch)
K to Q5 (If Black checks on Kt4, White also plays K to Q5)	R to B6
K to B6	R takes QP
R to Kt8, and Black could not avoid the draw, for if K to R2 the R checks on Kt7 and Kt8.	

The ingenious idea of placing the K on B6 and threatening a mate or a perpetual check with the Rook, led us to arrive at the following position when playing an actual game :—

BLACK.



WHITE.

White to play and draw.

It will be seen that we were trying to get a position which might give us a similar chance for a draw, and in spite of the fact of our opponent having three good pawns, we think a draw can be forced. We hope the preceding example will enable our readers to work out this very interesting position. We shall give our analysis next week.

PROBLEM No. 88.

By A. J. MAAS.

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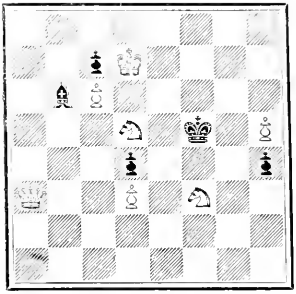

WHITE.

White to play and mate in three moves.

REVIEW.

CHESS BLOSSOMS.

MISS F. F. BEECHY, an experienced problem composer, has published a collection of her two-move problems. These compositions are of more than average merit, as proved by the fact of several of them having won prizes. The prize problems of English problem competitions for 1882 are appended, together with some readable (chessy) verses and poetry. This is a pleasant little book and is published by the authoress at Matlock, Bath.

ANSWERS TO CORRESPONDENTS.

**** *Please address Chess Editor.*

R. V. TYLEY.—Drawn games are sometimes counted half to each player.

W. TERRILL.—Could you kindly send a copy?

G. W. THOMPSON.—If P moves there is no mate.

W.—Solutions of Ending and Problems No. 86 and 87 correct.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 20, 1883.

Contents of No. 90.

A NATURALIST'S YEAR.

By Grant Allen.

XVII.—CRABS AND LOBSTERS.

Among the olive-green hanging seaweed that drops like a curtain from the landward side of this broken ledge of rock, I have just disentombed with my stick a little soft-shelled crab, who, bent on indulging his naturally retiring disposition, had taken refuge there in solitary security, when the tide began to leave his open feeding-grounds high and dry. See him scuttle hastily sideways now across the bare patch of beach, and make his way with all convenient speed towards the neighbouring pool, where he proceeds at once to bury himself, tail foremost, once more under the wet sand beneath the overhanging eaves of the ledges! How fast and how clumsily he runs! How quickly and yet how awkwardly he grubs his way into the yielding quicksands! A crab always suggests to one the notion of an animal that has not quite fully adapted itself to the conditions under which it is living. It seems to have learnt the trick fairly well, so to speak, but not to be able to perform it with perfect grace and ease. This is a feeling one often has about creatures which have widely diverged in habit, and especially in attitude, from the rest of their kind. They always seem to be clumsy in their movements. One notices it, among birds, in the penguin, the puffins, and many other erect species, as well as in the waddling of ducks; or among mammals, in the seals and their congeners, as well as in the kangaroos and jerboas. Nay, even man himself has something of the same awkwardness about him, for though he can walk well enough, he can't squat or sit gracefully without the aid of an artificial mechanism, such as a chair or a sofa. In all these cases, we may fairly say that the peculiar modification of the ancestral type for a special purpose has entailed a certain necessary clumsiness in other matters, because the original limbs were fitted for different ends from those to which they are now applied. The clumsiness is due, in fact, to what one may describe as patching and altering on the part of Nature.

The crab is an excellent example of such natural afterthoughts. By descent all crabs are, roughly speaking lobsters; or, to put it more correctly, both crabs and lobsters are derived from a single common ancestral form, from which the crab has diverged a great deal, while the lobster has diverged relatively little. Crabs, in fact, may be approximately described as the kind of lobsters that has taken to walking instead of swimming and jumping. If you compare a lobster with any one of its less developed relations, such as a prawn or a shrimp, you will see that while they differ in many important points of structure (which I leave aside, as belonging rather to the province of professional biologists, like Dr. Wilson, than of mere strolling field naturalists like myself), they agree in certain general proportions of the most conspicuous external parts. They have all long, large muscular tails, which contain the principal fleshy part of the body, and which, in fact, we all know particularly well, because they form the portion that we ourselves use as food, and they have a cylindrical head and chest (so to say), as well as a considerable number of swimming appendages. But if you compare a lobster with a crab you will find that, while they agree with one another in many important points of structure far more closely than they do with their lower relations, they yet differ in general outward appearance far more widely than the prawn and shrimp. It is these conspicuous outward differences—merely adaptive points to the true biologist—that most require explanation in the eyes of the world at large. The other matters are the really important ones—the ones on which the science of biology must be fundamentally based; but these are the ones that interest ordinary people the most.

Now, the adaptive differences between crabs and lobsters are all due to the initial fact that the crab is a walking crustacean, while the lobster is a jumping and swimming one. If you watch the lobsters in an aquarium, you will see that they hardly use their small legs for walking at all; they employ them almost entirely for standing, or rather for poising themselves lightly upon the shelves of rock where they love to loiter. There are two large muscular tracts in the lobster's body—the two parts which we mainly use for food; one is the big and powerful tail, which is the real organ of locomotion in the lobster; the other is the two great claws, which, of course, are used as organs of prehension and weapons of offence or defence. But if you look closely at a crab, you will find that though its members answer in the main, part for part, to the members of the lobster, its shape and relative development are very different. The tail, instead of being a large fleshy organ, capable of producing long and rapid springs through the water, is doubled up and tucked away under the crab's body; and, as we have frequently had occasion to observe when eating crab (the only form of dissection that most of us ever practise), it contains no meat worth the trouble of extracting. The fact is, most crabs have so long found their tails a mere incumbrance, and have consequently tucked them quietly away behind them, that they have gradually dwindled by disuse, in accordance with a well-known general law, that all parts which are seldom or never exercised tend slowly to atrophy and obsolescence. Use and disuse combine with natural selection thus to alter the forms of organs. A part which is much exercised tends to grow large and prominent; a part which is little exercised tends to fade imperceptibly away.

The other clause of this law is equally well exemplified in the body and legs of the crab. What most people naturally regard as the whole creature (barring the small and inconspicuous tail) answers in fact merely to the front half or "body" of the lobster; and as this part contains

the only organs of locomotion now practically used by the adult crab—namely, the legs—it has grown to a relatively immense and inordinate size. In a crab, we have all observed (also in pursuit of our personal objects) the meatiest part after the big grasping claws consists of the network of shell and muscles in the under portion of the body. Now, this part is really the governing and moving mechanism of the small legs, or, in other words, the muscles that actually do the work of walking. Hence it is easy to see why the crab differs so much in externals from the lobster. But, besides this main central difference, there are other minor differences of shape and appearance, due in like manner to adaptive modification. While the lobster's whole form is roughly cylindrical and pointed in front, so as to enable him to dart readily through the water with very little resistance, the crab's form is much more flattened and massive, so as to suit better with his crawling and almost terrestrial habits, as he makes his way quietly and unobtrusively along the bottom. The one type might almost be compared with that of the greyhound or the hare, the other with that of the tortoise or the armadillo. Indeed, the crabs are by far the most land-loving of all their immediate group, for most of them hug the shore, many of them live on the margin between high and low water, and not a few of them have actually taken to living on dry land, or even climbing considerable mountains. These last return annually to the sea in order to lay their eggs, and the young pass their early or larval stages as free swimming creatures in the salt water, but in their full-grown form they take at length to the land, and there grub away in the soil to their heart's content. Grubbing, in fact, even more than walking, might be set down as the peculiar differentia of the crab race, the one thing which, more than any other, has given the whole group its special and distinctive features. To my mind there is no more speaking lesson in evolution than just to buy a common edible crab, and look at the curiously dwarfed and dwindled condition of its tail. If that one simple concrete argument and example does not convert a man, he must be hard wedded indeed to his own view of the cosmos and its origin.

HOW TO GET STRONG.

REDUCING FAT.

IT is hard to say whether corpulence is to be regarded as a greater nuisance in its direct or in its indirect effects —whether it is worse to be loaded constantly with the weight of two or three suits of clothes, to have the circulation impeded, the liver obstructed, and the lungs oppressed, or to be rendered almost unable, and quite unwilling, to take such exercise as would open the lungs, free the liver, and stimulate the circulation. The mischief of corpulence works in a very vicious circle. It is an evil in itself, and it tends to increase its own evil effects.

At the very outset, then, of any system of exercise for those who are oppressed with much fat, comes the inquiry, how that excess of adipose tissue is to be reduced. Observe, I say "fat," not "flesh." It is absurd to speak of fat men as fleshy men. No one is the worse for flesh, nor can there well be excess of it; for flesh is muscle. It is excess of fat only which is obnoxious; and because, amongst other reasons, wherever there is excess of fat there is defect or deterioration of flesh.

Now, with regard to the reduction of fat, there are a dozen or so of methods which are in more or less favour with those whom Dr. Dio Lewis calls the "wobblers," though in England, at any rate, many fat men walk as steadily, in appearance, as the lean ones. I do not, for my own part, believe in any one of these methods; but I believe in all or very nearly all of them. This sounds like a contradiction; but it is not. I think the fat man who pins his faith on this, that, or the other cure for obesity, is not only unlikely to get rid of his extra fat, but is very likely to do himself serious mischief. But I think also that the man who pins his faith on this, that, *and* the other cure, is very likely, if he is patient and resolute, to be successful in reducing himself to reasonable proportions. It is by applying all the proper remedies (for some are obviously bad) at the same time, and in due proportion, that fat may be reduced most safely and most effectively.

But in the struggle with obesity, resolution, self-restraint, and patience are all important. Unfortunately, fat is very often an evidence of impatience, weak will, and want of self-restraint. Also of want of wisdom. The pleasure of a goodly meal, swallowed hastily (that is, without due patience in mastication), washed down (hateful, but in such cases too appropriate expression) by draughts of wine, or beer, or spirits, and followed by fat-engendering repose, seems greater than the enduring pleasure of good digestion, active frame, and light spirits, with the power to limit sleep to sleep's proper hours. A quiet read in a soft arm-chair by the fire-side in winter, or in the cool, softly-lit study in summer, seems a greater good, even when taken at the expense of exercise which the body needs, than the less-noticed, but longer lasting, sweetness of health and cheerfulness secured by a wholesome regimen.

The necessary resolution, patience, and self-restraint to reduce excess of fat can be obtained in no other way that I know of than by reasoning. Let a man consider within himself what he pays for those indulgences which keep him fat, and he must be foolish, I take it, if he is unwilling to give them up or to reduce them in such degree as may be necessary. Nay, let him even consider the matter in the light of such indulgences. Does he enjoy his food as much when over-burdened with fat as he would if he were in better condition? Does he enjoy the rest he takes unnecessarily anything like the rest he would *want* if he were more active? In fact, does he know the real pleasure afforded by either feeding or resting? One meal sauced by hunger is worth a dozen eaten when the system is already over-loaded. One rest earned by exercise is worth any amount of lounging laziness. Then again, consider the work a fat man has to do as a direct result of shirking work he ought to do. The man who has been unwilling to walk four or five miles a day when of reasonable weight, has no choice later (unless he summons resolution and patience to his aid) but to carry about with him wherever he goes a load of perhaps forty or fifty pounds of useless muscle-encumbering fat. A man who is unwilling to put on a suit of flannels and a "sweater," weighing, perhaps, two or three pounds more than his usual dress, to work off a pound or two of his weight, carries about with him (groaningly, it may be, but still unresistingly) the weight of five or six complete suits of clothing.* A man who is unwilling to sweat for his health, sweats daily four or five times as much as leaner men, though what he so loses he replaces by heavy draughts, not always of innocuous water.

So much premised, and noting also that to follow at once several fat-reducing methods is much easier, as it will be found much more effective and therefore much more encouraging than to follow one, I proceed to consider

* A summer suit of clothes for a man of medium size (height and stoutness) weighs about 8 lb., including boots and hat. A fat man not only carries 40 lb. or 50 lb. more weight of his own than he need, but has to have rather heavier clothing.

the various methods available for attacking superabundant fat, hoping that many overweighted persons among my readers may take courage to enter systematically and patiently on the profitable work of fat-reduction.

I begin with medicinal systems as on the whole the least useful methods, and those which need to be most cautiously applied, where applied at all. (I say nothing of corset or busk wearing, partly because in a former paper I said enough of that foolish plan, only fit for those whose resolutions needs bolstering up artificially. I note only in passing that our editor must have been of most inquiring disposition to put so obviously unnatural a method to the test.)

Nearly all medical methods for the reduction of at depend in reality on the amount of mischief which may be done by medicines to the digestive system and to the appetite. If a man takes an emetic four or five times a day, and a strong aperient twice or thrice a day, he would, probably, be considerably reduced at the end of two or three weeks, supposing he survived. It is easy to devise medical systems which, without being quite so obviously pernicious, would do so much mischief that a man's weight would soon be much reduced, and also his strength. Of such systems nothing good can be said. Akin to them are such methods as depend on dosing the food with vinegar, or otherwise making it either unpalatable or unprofitable. Yet medicines may be used, especially at the beginning of a course of fat-reduction, with some advantage, if wisely administered—which should be done by medical advice. The fat man is in an unwholesome state, and though he may be able to get better without medicine, he may save some trouble by taking such medicines as a sensible doctor may consider suitable to help the action of the stomach, the liver, the kidneys, and the skin. Albeit, recourse should only be had, in my opinion, to the doctor, in very bad cases, or where, as sometimes happens, the first application of other and better methods leads to constipation, chills, headaches, and other forms of mischief. These are so apt to dishearten the struggler against fat, that it may often be well to give the disordered, impeded, or congested organs a little help from judiciously-selected drugs.

(To be continued.)

THE CHEMISTRY OF COOKERY.

XIV.

By W. MATTIEU WILLIAMS.

IN my last I described the dissociation of sugar by hea and the formation of caramel, to illustrate by simple example the "browning" of other kinds of food. I might have added, in connection with this cookery of sugar, an historical connection with one of the lost arts of the kitchen —viz., the "spinning" of sugar. Within the reach of my own recollection no evening party could pretend to be stylish unless the supper-table was decorated with a specimen of this art—a temple, a pagoda, or something of the sort done in barley-sugar. These were made by raising the sugar to 320°, when it fused and became amorphous, or vitreous, as already described. The cook then dipped a skewer into it, the melted vitreous sugar adhered to this and was drawn out as a thread, which speedily solidified by cooling. While in the act of solidification it was woven into the desired form, and the skilful artist did this with wonderful rapidity. I once witnessed with childish delight the spinning of a great work of art by a French cook in St. James's Palace. It was a ship in full sail, the sails of edible wafer, the hull a basket work of spun sugar, the masts of massive sugar-sticks, and the rigging of delicate threads of the same. As nearly as I can remember, the whole was completed in about an hour.

But to return from high art to chemical science. The conversion of sugar into caramel is, as already stated, attended with a change of flavour; a kind of bitterness replaces the sweetness. This peculiar flavour, judiciously used, is a powerful adjunct to cookery, and one which is shamefully neglected in our ordinary English domestic kitchens. To test this, go to one of those Swiss restaurants originally instituted in this country by that enterprising Ticinese, the late Carlo Gatti, and which are now so numerous in London and our other large towns; call for *maccaroni al sugo*; notice the rich, brown gravy, the "sugo." Many an English cook would use half-a-pound of gravy beef to produce the like, but the basis of this is half-an-ounce of sugar, or even less; the sugar is browned by heating, not quite up to the caramel state. Burnt onion may contribute, but this is only another form of caramel with more savoury properties.

While engaged upon your maccaroni, look around at the other dishes served to other customers. Instead of the pale slices of meat spread out in a little puddle of pale, watery liquid, that are served in English restaurants of corresponding class, you will see dainty morsels, covered with rich, brown gravy, or surrounded by vegetables immersed in the same. This sugo is greatly varied according to the requirements, by additions of stock-broth, tarragon vinegar, ketchup, &c., &c., but burnt sugar, or burnt onions, or burnt something is the basis of it all, sugar being the cheapest.

To further test the flavouring properties of browning, take some eels cut up as usual for stewing; divide into two portions; stew one brutally—by this I mean simply in a little water—serving them with this water as a pale gravy or juice. Let the second portion be well fried, fully browned, then stewed, and served with brown gravy. Compare the result. Make a corresponding experiment with a beef-steak. Cut it in two portions; stew one brutally in plain water; fry the other, then stew it and serve brown.

Take a highly-baked loaf, better one that is black outside; scrape off the film of crust that is quite black, *i.e.*, completely carbonised, and you will come to a rich brown layer, especially if you operate upon the bottom crust. Slice off a thin shaving of this, and eat it critically. Mark its high flavour as compared with the comparatively insipid crumb of the same loaf, and note especially the resemblance between this flavour and that of the caramel from sugar, and that of the browned eels and browned steak. A delicate way of detecting the flavour due to the browning of bread is to make two bowls of bread and milk in the same manner, one with the crust, the other with the crumb of the same loaf. I am not suggesting these as examples of better or worse flavour, but as evidence of the fact that much flavour of some sort is generated. It may be out of place, as I think it is, in the bread and milk, or it may be added with much advantage to other things, as it is by the cook who manipulates caramel and its analogues skilfully.

The largest constituent of bread is starch. Excluding water, it constitutes about three-fourths of the weight of good wheaten flour. Starch differs but little from sugar in composition. It is easily converted into sugar by simply heating it with a little sulphuric acid, and by other means of which I shall have to speak more fully hereafter when I come to the cookery of vegetables. When simply heated, it is converted into dextrin or "British gum,"

largely used as a substitute for gum arabic. If the heat is continued a change of colour takes place; it grows darker and darker until it blackens just as sugar does, the final resu't being nearly the same. Water is driven off in both cases, but in carbonising sugar we start with more water, sugar being starch plus water or the elements of water. Thus the brown material of bread-crust or toast is nearly identical with caramel.

I have often amused myself by watching what occurs when toast and water is prepared, and I recommend my readers to repeat the observation. Toast a small piece of bread to blackness, and then float it on water in a glass vessel. Leave the water at rest, and direct your attention to the under side of the floating toast. Little thread-like streams of brown liquid will be seen descending in the water. This is a solution of the substance which, if I mistake not, is a sort of caramel, and which ultimately tinges all the water.

Some years ago I commenced a course of experiments with this substance, but did not complete them. In case I should never do so, I will here communicate the results attained. I found that this starch caramel is a disinfectant, and that sugar caramel also has some disinfecting properties. I am not prepared to say that it is powerful enough to disinfect sewage, though at the time I had a narrow escape from the Great Seal Office, where I thought of patenting it for this purpose as a non-poisonous disinfectant that may be poured into rivers in any quantity without danger. Though it may not be powerful enough for this, it has an appreciable effect on water slightly tainted with decomposing organic matter.

This is a very curious fact. We do not know who invented toast and water, nor, so far as I can learn, has any theory of its use been expounded, yet there is extant a vague popular impression that the toast has some sort of wholesome effect on the water. I suspect that this must have been originally based on experience, probably on the experience of our forefathers or foremothers living in country places where stagnant water was a common beverage, and various devices were adopted to render it potable.

Gelatine, fibrine, albumen, &c.—*i.e.*, all the materials of animal food—as already shown, are composed, like starch and sugar, of carbon, hydrogen, and oxygen, with, in the case of these animal substances, the addition of nitrogen; but this does not prevent their partial carbonisation (or "caramelising," if I may invent a name to express the action which stops short of blackening). Animal fat is a hydro-carbon which may be similarly browned, and, if I am right in my generalisation of all these browning processes, an important practical conclusion follows, viz., that cheap soluble caramel made by skilfully heating common sugar is really, as well as apparently, as valuable an element in gravies, &c., as the far more expensive colouring matter of brown meat gravies, and that our English cooks should use it far more liberally than they usually do.

Its preparation is easy enough; the sugar should be gradually heated till it assumes a rich brown colour and has lost its original sweetness. If carried just far enough, and not too far, the result is easily soluble in hot water, and the solution may be kept for a long time, as it is by cooks who understand its merits. In connection with the idea of its disinfecting action, I may refer to the cookery of tainted meat or "high" game. A hare that is repulsively advanced when raw, may by much roasting and browning become quite wholesome, and such is commonly the case in the ordinary cooking of hares. If it were boiled or merely stewed (without preliminary browning) in this condition, it would be quite disgusting to ordinary palates.

A leg of mutton for roasting should be hung until it begins to become odorous; for boiling it should be as fresh as possible. This should be especially remembered now that we have so much frozen meat imported from the antipodes. When duly thawed it is in splendid condition for roasting, but is not usually so satisfactory when boiled. I may here mention incidentally that such meat is sometimes unjustly condemned on account of its displaying a raw centre when cooked. This arises from imperfect thawing. The heat required to thaw a given weight of ice and bring it up to 60°, is about the same as demanded for the cookery of an equal quantity of meat, and therefore, while the thawed portion of the meat is being cooked, the frozen portion is but just thawed, and remains quite raw.

A much longer time is demanded for thawing—*i.e.*, supplying 142° of latent heat—than might be supposed. To ascertain whether the thawing is completed, drive an iron skewer through the thickest part of the joint. If there is a core of ice within it will be distinctly felt by its resistance.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

INTRODUCTORY.

It is known to all who watch the signs of the times—obvious, indeed, to them, and known to many who are less observant—that those moral restraints which claim to be of sacred origin are no longer accepted by a large and increasing number of persons. I have no wish to inquire here whether those restraints should be regarded as of divine origin or not. I note only the fact that by many they are not so regarded. I am not concerned to ask whether it is well or ill that their authority should be rejected, and their controlling influence be diminishing or disappearing among many; it suffices, so far as my present purpose is concerned, that the fact is so. The question then presents itself, Does any rule of conduct promise to have power now or soon among those who have rejected the regulative system formerly prevalent? We need not consider whether such a rule of conduct, necessarily secular in origin, is in itself better or worse than a rule based on commandments regarded as divine. All we have at present to ask is whether such a regulative system is likely to replace the older one with those over whom that older law no longer has influence.

Here at the outset we find that those who hold extreme views on either side of the questions I have left untouched, agree in one view which is, I think, erroneous. On the one hand, those who maintain the Divine character of the current creed insist, not only that it is sufficient for all, but that, in the nature of things, no other guide is possible. On the other hand, those who reject the authority of that creed most energetically, assert as positively that no new regulative system, no new controlling agency, is necessary. As Mr. Herbert Spencer has well put it, "both contemplate a vacuum, which one wishes and the other fears." But those who take wiser and more moderate views, who, in the first place, recognise facts as they are, and, in the next, are ready to subordinate their own ideas of what is necessary or best for the ideal man to the necessities of man as he really is, perceive that for the many who no longer value a regulative system which, so far as they are concerned, is decaying, if not dead, another regulative system is essential. Again to use the words of the great philosopher whose teachings are to be our chief guide in this series of papers, "Few things can happen more

disastrous than the decay and death of a regulative system no longer fit" (for those we are considering), "before another and fitter regulative system has grown up to replace it."

My purpose in these papers is to show how rules of conduct may be established on a scientific basis for those who regard the so-called religious basis as unsound.* I shall follow chiefly the teachings of one who has inculcated in their best and purest form the scientific doctrines of morality, and may be regarded as head, if not founder, of that school of philosophy which, on purely scientific grounds, sets HAPPINESS as the test of duty—the measure of moral obligation. To Mr. Herbert Spencer we owe, I take it, the fullest and clearest answer to the melancholy question, Is Life Worth Living? whether asked whiningly, as in the feeble lamentations of such folk as Mr. Mallock, or gloomily and sternly, as in the Promethean groans of Carlyle. The doctrine that happiness is to be sought for oneself (but as a duty to others as well as to self), that the happiness of others is to be sought as a duty (to oneself as well as to them)—happiness as a means, happiness as the chief end—such has been the outcome of the much-maligned philosophy of Mr. Herbert Spencer, such has been the lesson resulting from his pursuance of what he himself describes as his "ultimate purpose, lying behind all proximate purposes," that of "finding for the principles of right and wrong in conduct at large, a scientific basis."

If I can help to bring this noble and beautiful doctrine—for noble and beautiful even those must admit it to be who deny its truth—before the many who regard Herbert Spencer's teachings with fear and trembling, not knowing what they are, I shall be content. But I would advise all who have time to read the words of the master himself. Apart from the great doctrines which they convey, they are delightful reading, clear and simple in language, graceful and dignified in tone, almost as worthy to be studied as examples of force and clearness in exposition as for that which nevertheless constitutes their real value—the pure and beautiful moral doctrines which they offer to those over whom current creeds have lost their influence.

Let me hope that none will be deterred from following this study, by the inviting aspect of the moral rules advanced by the great modern teacher—even as in past times men were anxious, or even angry, when another teacher showed more consideration for human weaknesses than had seemed right to the men of older times. I will not ask here whether doctrines of repellant aspect are likely to be more desirable than those which are more benignantly advanced. It suffices that with many the former now exert no influence, whether they should do so or not. So that, as far as these (for whom I am chiefly writing) are concerned, all must admit the truth of what Mr. Spencer says respecting the benefits to be derived from presenting moral rule under that attractive aspect which it has when undisturbed by superstition and asceticism. To close these introductory remarks by a quotation from the charming pages of his "Data of Ethics":—

"If a father, sternly enforcing numerous commands, some needful and some needless, adds to his severe control a behaviour wholly unsympathetic—if his children have to take their pleasures by stealth, or, when timidly looking up from their play, ever meet a cold glance, or more frequently a frown, his government will inevitably be disliked, if not hated; and the aim will be to evade it as much as possible. Contrariwise, a father who, equally firm in maintaining restraints needful for the well-being of his children or the well-being of other persons, not only avoids needless restraints, but, giving his sanction to all legitimate gratifications, and providing the means for them, looks on at their gambols with an approving smile, can scarcely fail to gain an influence which, no less efficient for the time being, will also be permanently efficient. The controls of such two fathers, symbolise the controls of morality as it is and morality as it should be."

(*To be continued.*)

* I say "so-called," referring rather to the *word* "religious" than to any question concerning the divine origin of current creeds. Strictly speaking, the word religious may be as correctly applied to moral rules based on scientific considerations, as to those formulated in company with any of the diverse creeds prevailing among men.

THE BIRTH AND GROWTH OF MYTH.

By EDWARD CLODD.

XI.

THE belief that human beings could change themselves into animals was alluded to in my remarks on witchcraft, but, in view of its large place in the history of illusions, too incidentally, and it is proposed to give it further reference here.

Superstitions which now excite a smile, or which seem beneath notice, were no sudden phenomena, appearing now and again at the beck and call of wilful deceivers of their kind. That they survive at all, like organisms, atrophied or degenerate, which have seen "better days," is evidence of remote antiquity and persistence. Every seeming vagary of the mind had serious importance, and answered to some real need of man as a sober attempt to read the riddle of the earth and get to its inmost secret.

So with this belief. It is the outcome of that early thought of man which conceived a common nature and fellowship between himself and brutes, a conception based on rude analogies between his own and other forms of life, as also between himself and things without life, but having motion, be they waterspouts or rivers, trees or clouds, especially these last, when the wind, in violent surging and with howling voice, drove them across the sky. Where he blindly, timidly groped, we walk as in the light, and with love that casts out fear. Where rough resemblances suggested to him like mental states and actions in man and brute, the science of our time has, under the comparative method, converted the guess into a certainty; not to the confirmation of his conclusions, but to the proof of identity of structure and function, to the demonstrating of a common origin, however now impassable the chasm that separates us from the lower animals.

The belief in man's power to change his form and nature is obviously nearly connected with the widespread doctrine of metempsychosis, or the passing of the soul at death into one or a series of animals, generally types of the dead man's character, as where the timid enter the body of a hare, the gluttonous that of a swine or vulture.

"Fills with fresh energy another form,
And towers an elephant or glides a worm;
Swims as an eagle in the eye of noon,
Or wails a screech-owl to the deaf, cold moon,
Or haunts the brakes where serpents hiss and glare,
Or hums, a glittering insect, in the air."

But while in transmigration the soul returns not to the body which it had left, transformation was only for a time, occurring at stated periods, and effected by the will of the transformed, or by the aid of sorcery and magic, or

sometimes imposed by the gods as a punishment for impious defiance and sin.

Other causes, less remote, aided the spread of a belief to which the mind was already inclined. Among these were the hallucinations of men who believed themselves changed into beasts, and who, retreating to caves and forests, issued thence howling and foaming, ravening for blood and slaughter; hallucinations which afflicted not only single persons, as in the case of Nebuchadnezzar, whose milder monomania (he, himself, saying in the famous prize poem :—

> "As he ate the unaccustomed food,
> It may be wholesome, but it is not good,")

rather resembled that of the daughters of Prætus, who believed themselves cows, but which also spread as virulent epidemic among whole classes. It is related that, in 1600, multitudes were attacked by the disease known as lycanthropy, or wolf-madness (from Greek, *lukos*, a wolf, and *anthropos*, a man), and that they herded and hunted in packs, destroying and eating children, and keeping in their mountain fastnesses a cannibal or devil's sabbath, like the nocturnal meetings of witches and demons known as the Witches' Sabbath. Hundreds of them were executed on their own confession, but some time elapsed before the frightful epidemic, and the panic which it caused, passed away. Besides such delusions, history down to our own time records instances where a morbid, innate craving for blood, leading sometimes to cannibalism, has shown itself. Mr. Baring-Gould, in his "Book of Werevolves," cites a case from Gall of a Dutch priest who had such a desire to kill and to see killed that he became chaplain to a regiment for the sake of witnessing the slaughter in battle. But still more ghastly are the notorious cases of Elizabeth, an Hungarian lady of title, who inveigled girls into her castle and murdered them that she might bathe her body in human blood to enhance her beauty; and of the Maréchal de Retz who, cursed with the abnormal desire to murder children, allured them with promises of dainties into his kitchen, and killed them, inhaling the odour of their blood with delight, and then burned their bodies in the huge fireplace in the one room devoted to these horrors. When the deed was done, the Maréchal would lie prostrate with grief, "would toss weeping and praying on a bed, or recite fervent prayers and litanies on his knees, only to rise with irresistible craving to repeat the crime."

Such instances as the foregoing, whether of delusion or morbid desire to destroy, are among secondary causes; they may contribute, but they do not create, being inadequate to account for the world-wide existence of transformation myths. The animals which are the supposed subject of these vary with the habitat, but are always those which have inspired most dread from their ferocity. In Abyssinia we find the man-hyæna; in South Africa, the man-lion; in India, the man-tiger; in Northern Europe, the man-bear; and in other parts of Europe the man-wolf, or were-wolf (from A.-S. *wer*, a man).

Among the many survivals of primitive thought in the Greek mythology, which are the only key to its coarser features, this of belief in transformation occurs, and, indeed, along the whole line of human development it appears and re-appears in forms more or less vivid and tragic. The gods of the South, as of the North, came down in the likeness of beasts and birds, as well as of men, and among the references to these myths in classic writers, Ovid, in the "Metamorphoses," tells the story of Zeus visiting Lykaon, king of Arcadia, who placed a dish of human flesh before the god to test thereby his omniscience. Zeus detected the trick, and punished the king by changing him into a wolf, so that his desire might be towards the food which he had impiously offered to his god.

> "In vain he attempted to speak; from that very instant
> His jaws were bespluttered with foam, and only he thirsted
> For blood, as he raged amongst flocks and panted for slaughter.
> His vesture was changed into hair, his limbs became crooked.
> A wolf—he retains yet large traces of his ancient expression,
> Hoary he is as afore, his countenance rabid,
> His eyes glitter savagely still, the picture of fury."

But we may pass from this and such-like tales of the ancients to the grim realities of the belief in mediæval times.

LAWS OF BRIGHTNESS.

VI.

By Richard A. Proctor.

Zöllner, as I have said, regards the full moon as though she were a nearly flat disc under full solar illumination. He estimates the brightness of the full moon at $\frac{1}{619,600}$ of the sun's, and, comparing surfaces, he makes the sun's brightness equal to 618,000 times the moon's. Now, it is easy to determine what would be the brightness of the full moon supposing the surface perfectly reflective (not specularly) and smooth, and regarding it as a flat disc. Such a disc, placed where the moon is, would be illuminated by a sun about 32′ in diameter, since the sun appears as large seen from the moon as seen from the earth. Now, such a sun would occupy a part of the whole heavenly sphere represented by the proportion $\frac{\text{vers . } 16'}{2 \text{ . rad}}$ or 0·0000054. But the brightness of such a disc, supposed to be illuminated by both halves of a complete enclosing sphere of solar brightness, would be the same as the sun's brightness. Now, different parts of such enclosing sphere would illuminate the disc at different angles, and, therefore, we must not consider the mere area of the sphere. Thus, the portion P, Fig. 13, of such a sphere (the radius may be any whatever) would illuminate D obliquely, and with an effect reduced from

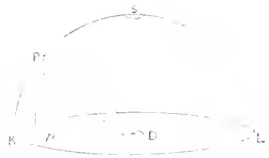


Fig. 13.

what would result if the illumination were direct, in the proportion of the sine of arc P K to unity. But it is obvious that the little area p, which is the orthogonal projection of P on K L (the plane of D), bears just this proportion to P. Hence the illuminating effect of the area P may be represented by the area p, and the total illuminating effect of the hemisphere will be represented by the area of the circle K L. Thus, for the whole sphere, we get twice the area K L, instead of the area of the sphere (which is four times this circle). Thus, the actual illumination of the supposed disc placed where the full moon is, bears to solar brightness the ratio of area S (representing

the space on the heavens occupied by the sun, supposed vertical) to half the area of the whole sphere, or the ratio

$$108 : 10{,}000{,}000$$

or

$$1 : 92{,}592.$$

If we suppose the disc replaced by a smooth spherical moon, we must increase 92,592 in the ratio of 3 to 2, getting the ratio

$$1 : 138{,}888.$$

Now, the actual quantity of light received from the moon is about 1,618,000th of the sun's light, or less than the 92,592nd part in the ratio

$$92{,}592 \text{ to } 618{,}000,$$

which would give the moon's reflective power (on the assumption of her reflecting as a flat disc, and of her disc being as large as the sun's), the value

$$\frac{92{,}592}{618{,}000};$$

but taking into account the smaller mean disc of the moon, we deduce the value 0·16 approximately. Taking the moon as a smooth sphere, we obtain the value 0·24. Now, Zöllner gives the value 0·1736, which is much nearer the former than the latter value. This is what, following Lambert, he calls the *albedo*, or whiteness of the moon; and he justly remarks that, taking her whole brightness, the moon must be regarded as more nearly black than white. But he adds that from his estimates of the illumination of the moon's brighter or brightest parts, he is satisfied that their whiteness can be compared with that of the whitest of terrestrial substances—or, to use his own words, he has arrived at the result "dass der Mond an seinen *helleren* und *hellsten* stellen aus einem Stoffe besteht, der, auf die Erde gebracht, zu den weissesten der uns bekannten Korper gezählt werden würd."

Zöllner gives the following determination of the *albedines* or *whitenesses* of different terrestrial substances:—

By diffused reflected light—	
Snow just fallen	0·783
White paper	0·700
White sandstone	0·237
Clay marl	0·156
Quartz porphyry	0·108
Moist soil	0·079
Dark gray syenite	0·078
By regular reflection—	
Mercury	0·648
Speculum metal	0·535
Glass	0·040
Obsidian	0·032
Water	0·021

It will be noticed how closely Zöllner's result accords with the statement of Sir John Herschel that the moon's average brightness does not exceed that of sandstone. "The actual illumination of the lunar surface is not much superior," Herschel says, "to that of weathered sandstone rock in full sunshine. I have frequently compared the moon setting behind the grey perpendicular façade of the Table Mountain, illuminated by the sun just risen in the opposite quarter of the horizon, when it has been scarcely distinguishable in brightness from the rock in contact with it. The sun and moon being nearly at equal altitudes, and the atmosphere perfectly free from cloud or vapour, its effect is alike on both luminaries."

It follows, of course, that since the brightest portions of the moon's surface are four or five times as bright as her average or mean illumination, the darkest portions are very much less bright than the average. We may assume that the floor of Plato, for instance (not absolutely the darkest part of the moon), is considerably darker even than dark grey syenite.

(*To be continued.*)

ARE COPPER SALTS POISONOUS?

TO most readers this will seem a foolish question, as from one generation to another people have been warned against pickles made green with copper salts, putting halfpence into the pot with peas or cabbages to ensure their coming to table with good complexions, and against cooking anything in copper vessels without special precautions to prevent the metal from being acted upon. It is hard to believe that all these warnings have been unnecessary, that so far from copper salts being mischievous, they can do no harm in the quantities likely to be found in food in consequence of the practices mentioned, and may even be of prophylactic use to the persons swallowing them. About a year ago a number of French doctors took copper-tinted peas and similar articles under their protection, and at the same time advocated the greatest care in keeping lead salts out of the way. They considered it very dangerous for tinned vessels intended to hold preserved meats or vegetables to be soldered inside, as the lead of the solder was likely to be acted upon, and even in very small quantities the lead salts would be dangerous. Copper salts are distinguished from lead salts in having no cumulative action upon the system, and symptoms of poisoning do not follow their repetition in minute doses, as they do in the case of lead. As a practical question, it is contended that the employment of copper as a food colouring agent ought not to be treated as an adulteration dangerous to health, and a decision in Belgium has been lately reported founded upon this view.

M. A. Gautier has recently published a work on "Copper and Lead in Alimentation and Industry," and his statements regarding the former metal coincide with those of previous French inquirers. He speaks of the presence of copper as a normal ingredient in many articles of food, such as wheat, barley, rice, beans, coffee, &c. The quantities in these cases are infinitesimal, but capable, in some instances, of producing a noticeable effect upon the creature swallowing them, as in the interesting case of the Turacous, whose fine red feathers Professor Church discovered to be coloured with a compound he named *turacine*, which was soluble in soft water, and contained a portion of copper derived from the fruits on which the birds feed.

M. Gautier finds in the articles of food above mentioned from four to ten milligrammes per kilogramme* of copper. Preserved aliments, such as vegetables and fruits, with copper "verdure clad," contain more of that metal—from ten to 200 milligrammes per kilogramme. Five milligrammes a day he reckons to be about the quantity commonly taken, and no inconvenience results from it. Chocolate is amongst the articles which, contrary to what might be expected, appear to contain a maximum of copper. The strong and repulsive flavour of copper salts limits the quantity anybody would be willing to swallow. When food is dosed with four grammes (over 61 grains) per kilogramme, it is too nasty to eat: but even then M. Gautier affirms it would not be dangerous to take. Copper salts soon act as an emetic, unless the quantity is small, and, according to the new views, poisoning by them is almost impossible. These opinions are founded upon experiments French doctors have made upon themselves and their friends. Dr. Galippe as far back as 1875 tried copper salts upon various animals, and acquired so much confidence in their innocence that he proceeded to take and give verdigris to his family and acquaintances without any mischief ensuing.

* The milligramme is ·0154 of a grain; the kilogramme 2 lb. 3 oz. 5 drams, or 15440·2344 grains.

According to these notions tinning copper vessels is not only unnecessary, but is a source of danger, as it is common to mix lead with the tin, partly because it is a much cheaper metal, and perhaps, still more, because it facilitates the process. Many of the disasters attributed to copper are now thought more likely to have been caused by the tinning. An unclean copper vessel is pronounced less dangerous than that one tinned with an alloy containing 10 per cent. of lead, and from 30 to 40 per cent. is found to be a common proportion. The chances of lead getting into the system are very great. The mischievous metal lurks in sardines, tunny, and lobster, as well as in the vegetables sold in tins. It is also to be found in shining wall-papers, certain table-cloths, the glazing of earthenware, and in a swarm of cosmetics.

In India, it is customary for Europeans to have all their cooking done in copper vessels, which are retinned every few weeks. In the army some precautions are taken to prevent the employment of a lead alloy in this process, but ordinary poisons are easily checked. When some of the so-called tinning is worn off the copper, the lead is more likely to be acted upon, and it is not improbable that some supposed copper poisonings have been effected by the lead. We should be glad if our medical readers in India would look into this question, and let us know the result.

Small doses of copper salts are supposed to exert a preservative action against typhoid fevers and some other complaints. Workers in copper and players upon copper and brass instruments are said to have escaped from typhoid poisoning better than other folks. Compared with the whole population, they are a very small class; there may be other things besides their contact with a particular metal that may help to secure their immunity. The question demands further inquiry.

THE FISHERIES EXHIBITION.

By John Ernest Ady.

III.

In that most delightful seaside resort in the Isle of Wight called Freshwater there is a bay adjoining the little hotel village known as Scratchell's Bay. The escarpment of the chalk cliffs, which descends abruptly for several feet to the level of the sea, shows in a most remarkable manner layer after layer of chalk, alternating with linear bands of flints. We have already solved the problem of the origin of the chalk with the assistance of the microscope, but how about the flint? It has been supposed that the flint derived its existence from the tests of *siliceous* organisms which abounded in the Cretaceous seas, and which have been dissolved and redeposited in that new and obscure shape. We pointed out before* that the tests of *Foraminifera* undergo profound changes at great depths, which result in the formation of a fine "red clay" (a silicate of iron and alumina) almost free from any traces of organised remains. We may now draw attention to the fact that in certain localities, *e.g.* the Gulf of Mexico, in comparatively shallow water (100 to 300 fathoms), the calcareous shells of the *Foraminifera* are subject to other changes, whereby the chambers of their tests become filled with a green material (also a silicate of iron and alumina), whilst the calcareous walls gradually disintegrate and finally dissolve, leaving behind the so-called "green sand" composed of a mass of exquisite casts or pseudomorphs of the shell chambers; these finally break down and crumble away into a formless paste, the vestiges of former animation. Evidences of the organic origin of vast azoic formations have thus been elucidated by the recent researches of the deep sea explorations, and suggested to the mind of the late Sir Wyville Thomson that many of the most ancient (Cambrian and pre-Cambrian) rocks, such as the highly-metamorphosed slates, &c., may possibly have been derived from foraminiferal and other remains. Whilst noting these phenomena, Huxley* observes that the words of Linnæus may be literally true when he says:—

"Petrefacta non a calce, sed calx a petrefactis. Sic lapides ab animalibus, nec vice versâ. Sic rupes saxei non primævi, sed temporis filiæ."

And he adds:—

"And there may be no part of the common rocks, which enter into the earth's crust, which has not passed through a living organism at one time or another."

But apart from the silent flints and clays, there are large zones of the crust of the earth which testify aloud to the former existence of myriads of lovely organisms which resemble the *Foraminifera* in many things, but are possessed of siliceous instead of calcareous tests. These *Radiolaria* form great masses of rock in the Barbadoes. Fig. 6 is a

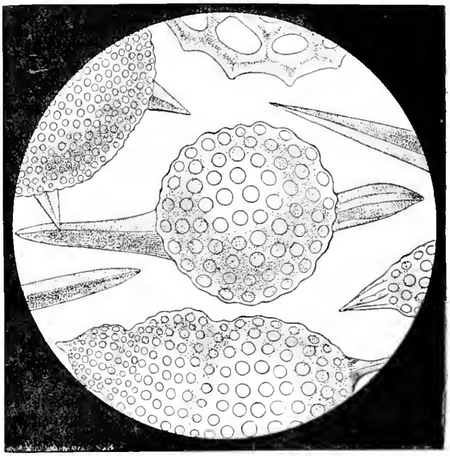


Fig. 6.—Polycystina, "Barbadoes earth." Tertiary deposits, Springfield, Barbadoes. × 300 diameters. (*Original.*)

drawing, magnified 300 diameters, of some of these beautiful skeletons. They are called *Polycystina*, and may be readily obtained for examination by the following method:—

Procure a small piece of the friable rock known as "Barbadoes earth," put it into a large test-tube, and add equivalent bulks, each of water and washing soda; boil for about one hour. The upper pellicle must now be poured off, fresh water and washing soda added, and the boiling continued. These processes should be repeated a third, and, if necessary, a fourth, fifth, and sixth time, until a fairly cleansed residue is left. The deposit thus obtained may be calcined by the application of a strong heat if the objects are to be examined by condensed reflected light under the microscope; but this further process is unnecessary if they are to be mounted in a transparent medium, and observed with transmitted light. Thus prepared they will be freed from adhering extraneous particles, and will present the wonderful beauty and symmetry which has been outlined in Fig. 6.

* Ut supra, p. 8.

* "The Anatomy of Invertebrated Animals," p. 87.

Now let us endeavour to show what relation these pretty shells hold to the bodies which have produced them. The reports of the *Challenger* expedition have shown that the *Radiolaria* of the great oceans usually live towards the surface, and that their skeletons, like those of the *Globigerinæ*, are being continuously showered down on to the bed of the deep sea from its surface waters. Unlike the *Globigerinæ*, however, the *Radiolaria* prefer to live in the temperate zones of the world; at about 55 deg. on either side of the equator the *Globigerinæ* commence to become meagre in size, and to gradually disappear, whilst the *Radiolaria* increase in numbers and arrive at their climacteric towards the circumpolar areas, where they are superseded by Diatomaceous plants.

The simplest form of Radiolarian is one which is common in fresh-water ponds, the sun-animalcule (Fig. 7), or *Actinosphærium Eichhornii.*

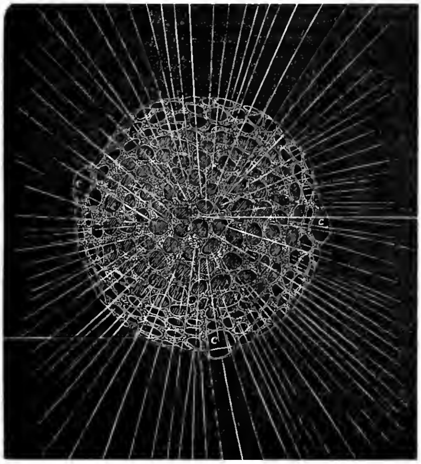


Fig. 7. *Actinospherium Eichhornii.* *c c c*, contractile vacuoles. (From a drawing by H. E. Forrest, in T. Bolton's Portfolio.)

This interesting creature, which has been carefully studied by Hertwig and Lesser,* may often be seen under the microscopes at Stand 756 in the Exhibition. The figure here given is reproduced from Mr. Bolton's well-known portfolio of drawings.

The *Radiolaria* are provided with stiff, usually straight, but sometimes anastomosing pseudopodia, the coalescence of which, however, can be immediately separated at the will of the animal. The centre of the body possesses a dense, protoplasmic capsule, which sometimes contains only a globule of oil, and there are one or more contractile vacuoles in *Actinosphærium*, but not in the other forms. The pseudopodial protoplasm is everywhere studded with yellowish celleform bodies, which are said to be composed of a material like *glycogen*, or animal starch, and it is in this layer also that the beautiful siliceous skeleton is elaborated. *Actinosphærium* does not generally possess any skeleton, but some of its allies are provided with spicules of siliceous matter.

Nearly all the *Radiolaria* are marine, of minute size, and simple; but there are a few which live together and form compound gelatinoid masses at the surface of the sea, such are *Sphærozoüm*, *Collosphæra*, and *Thalassicolla*.

* Ueber Rhizopoden, "Archiv für mikroskopische Anatomie," 1876.

In our next issue we propose to give a fully illustrated account of the beautiful and useful sponges which adorn many of the galleries in the Exhibition, to briefly point out their affinities, and to show the structural relationships which exist between the living tissues of these curious animals and the skeletons which are so much prized, both for domestic purposes and as ornaments.

(*To be continued.*)

FLIGHT OF A VERTICAL MISSILE.

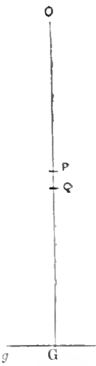
By RICHARD A. PROCTOR.

PROP.—*A body is projected vertically to a height,* h, *in time* t_1 *(resistance of the air neglected). If we sum up all the westerly deflections due to the difference between the eastwardly motion at points above the earth's surface, and at the surface itself, what total westerly deflection do we obtain? and how is the difference between the westerly deflection so obtained and the real deflection to be explained?*

Consider only the fall of the body; since manifestly the westerly deflection obtained in this (incorrect) manner, will be the same for the rise as for the fall.

Let O be the point from which the body falls, gGg' the ground, $OG=h=\frac{g}{2}t^2$.

Let the falling body be at P after time t, then $OP=\frac{gt^2}{2}$, and $GP=h-\frac{gt^2}{2}$. In time dt the body at P is carried eastward with the eastwardly motion of G, while the point P vertically above G is carried eastwards with the greater motion due to the height of P above G. The motion of G in time dt is $\frac{dt}{P}\cdot 2\pi r$ (where P is the earth's rotation period, and r the earth's radius). Therefore the westerly deflection in time dt—



$$=\frac{dt}{P}\left[2\pi\left(r+h-\frac{gt^2}{2}\right)-2\pi r\right]$$

$$=\frac{2\pi}{P}\left(h-\frac{gt^2}{2}\right)dt$$

Consequently, the total westerly deflection during the fall,

$$=\frac{2\pi}{P}\int_0^{t_1}\left(h-\frac{gt^2}{2}\right)dt$$

$$=\frac{2\pi}{P}\left[ht_1-\frac{gt_1^{\,3}}{6}\right]$$

$$=\frac{2\pi}{P}\left[ht_1-\frac{ht_1}{3}\right]$$

$$=\frac{4\pi h}{P}\,\frac{t_1}{3}$$

or total westwardly deflection during ascent and descent,

$$=\frac{8\pi h}{3P}t_1.$$

Let us try this problem another way. Put O $P=x$, P $Q=dx$. Then time of falling through P $Q=\frac{dx}{\sqrt{2gx}}$; and during this time the body gains a westerly deviation corresponding to the excess of the eastwardly motion of the

point x over that of the point G, during that interval; or

$$\left[\frac{2\pi}{P}(r+h-x)-\frac{2\pi r}{P}\right]\frac{dx}{\sqrt{2gx}}$$

$$=\frac{2\pi}{P}\frac{h-x}{\sqrt{2gx}}dx$$

$$=\frac{2\pi}{P\sqrt{2g}}\left(\frac{h}{\sqrt{x}}-\sqrt{x}\right)dx$$

∴ total westwardly deflection

$$=\frac{2\pi}{P\sqrt{2g}}\int_0^h\left(hx^{-\frac{1}{2}}-x^{\frac{1}{2}}\right)dx$$

$$=\frac{2\pi}{P\sqrt{2g}}\left(2h^{\frac{3}{2}}-\tfrac{2}{3}h^{\frac{3}{2}}\right)$$

$$=\frac{8\pi h^{\frac{3}{2}}}{3P\sqrt{2g}}=\frac{4\pi h}{3P}\sqrt{\frac{2h}{g}}=\frac{4\pi h}{3P}t_1$$

or westwardly deflection during ascent and descent

$$=\frac{8\pi h}{3P}t_1$$

as before.

The real deviation, as shown at pp. 10, 11, is twice as great. The error manifestly arises from our not taking into account the fact that gravity does not act throughout the flight at right angles to the course which the body originally possessed in a horizontal direction. In our next we shall consider the problem analytically with due reference to this point, which, though it may seem slight, really causes the deviation to be twice as great as it would be were the directions of gravity on the falling body parallel throughout the flight.

A CONTEMPORARY says that by a recent analysis of tobacco-smoke, MM. G. Le Bon and G. Noel have extracted bottles of—(1) Prussic acid; (2) an alkaloid of an agreeable odour, but dangerous to breathe, and as poisonous as nicotine, since one-twentieth of a drop destroys animal life; (3) aromatic principles, which are as yet undetermined, but which contribute, with the alkaloid, to give the smoke its perfume. The alkaloid appears to be identical with collidine, which has been observed in the distillation of many organic substances, but its physiological and poisonous properties have been hitherto unknown.

FLOATING DOMES FOR TELESCOPES.—The Paris Observatory, requiring for a new telescope a dome 20 mètres, or rather more than 65 feet 7 inches in diameter—the size of that of the Pantheon—it was resolved to accept a proposal of Eiffel to make it float in an annular tank, to be filled with water containing chloride of magnesium, to prevent its freezing in the winter. This being mentioned as quite a novelty in a Report of the Observatory issued in February, M. Merten explains in *Ciel et Terre* that a floating structure was proposed by Van Rysselberghe in 1880, and accepted in May, 1882, for the new Observatory in the environs of Brussels, with some improvements in detail devised by MM. Royers, engineers to the city of Antwerp. There is to be an annular tank, filled with a mixture of three parts of water and one of glycerine, and in it a float of corresponding shape, carrying a cylindrical superstructure, with a sliding-roof opening half way. By a simple mechanism, the whole cylinder will have a revolving motion, and also be capable of elevation and depression, so that when required the telescope may be completely uncovered.

Editorial Gossip.

READERS of KNOWLEDGE may, perhaps, be interested to learn how pleasantly and successfully the holiday lectures, which began with my course of six at St. Leonards-on-Sea, are progressing. We have begun with the south-east of England, and are working steadily westwards and northwards at present, though it is probable that we shall return to some of the places where we have been most agreeably greeted. At present (Saturday, July 14th) thirty-five of these summer lectures have been given at St. Leonard's-on-Sea, Tunbridge Wells, Eastbourne, Worthing, Folkestone, Brighton, Dover, Deal, Portsmouth, Ashford, and Chichester.

ALTHOUGH I have been pleased, and even surprised, considering the season, at the welcome given me at all these places, I have had to note at some of them—especially at Chichester, Ashford, and Deal, a rather amusing slowness of apprehension, not in those who have come to the lectures, but in those who have not come. I get multitudes of letters after I have left a place, telling me how gladly the writers would have come to the lectures if they had known that they were so easily to be understood even by persons not much acquainted with astronomy. They find this out rather late, considering I have lectured now for nearly fourteen years, and always on the same plan. Then they ask me to return, either repeating my lectures or giving others of the series. But of course it is precisely to the places where these erroneous ideas have prevailed that I am least likely to return. I might possibly, at a second visit, see those who, "had they but known," &c., as they write, would have attended the first series; but though that might suit them, it would be very inconvenient to me. It is not only as easy to address a thousand as to address five hundred, but far easier—to say nothing of the circumstance that if the thousand divide into two audiences of five hundred, all expenses are doubled.

THEN, as to time; we calculate that to work through England and Wales, Scotland, and Ireland, as we propose to do, will take not less than two years, and that is all the time I can spare. I put off my return to America till the autumn of 1885, but I can put it no further off. Therefore, though exceptional success may encourage me to return to certain places, or to give more lectures than I had originally intended, it is impossible for me to make two visits to places where half of those who wish to hear me only find out their wish after I have left.

IN the last number but one appeared a short extract from the *Spectator* (from the pen, I imagine, of Mr. Richard H. Hutton), headed "God's Will." This has caused some correspondents to send me a few very singular letters. When I receive a single particularly foolish letter on a subject, I generally assign it to some "local lunatic" who has been unwisely entrusted with pen and paper. But when several such letters appear, I begin to think there is some reason for their writers' mistakes. Yet in this case, what *can* be the reason? A writer thoughtfully propounds anew the old, old mystery, the existence—nay, the general prevalence—of evil. Stating at the outset his belief that God governs as well as reigns, he shows what a mystery God's government is. He points to the vast, unending, inexplicable waste of life, to the miseries endured by too many of those who live, and shows that for us there is no solution to the awful problem. On this, there fall

upon him and upon me certain feeble-minded folk, who think they do good service by offering God the unclean sacrifice of falsehood, who tell us there is no mystery, there need be no evil, there should be no sorrow. They quote words from the Bible, words which really mean precisely what was said here, only they mistake "resignation to an inexplicable Will" for recognition of what that Will may be. Their appeal is to Cæsar, to Cæsar let them go. *Is* there no evil, and need there be no sorrow? Where, then, is it written that "man is born to sorrow as the sparks fly upward?" *Can* we, in truth, by study recognise God's will, can we see its perfection? Where, then, is it written: "Canst thou by searching find out God? Canst thou find out the Almighty unto perfection? Higher than heaven what canst thou know? Deeper than hell what canst thou do? As touching the Almighty, we cannot find Him out?" We can but believe, we cannot know, for "knowledge is of things we see," and God—we know—is "more than they."

Someone forwards me, apparently for notice, the following extract from the *Northern Whig* (Belfast):—

"For some time past scientific men have pointed out that the fixed stars are not fixed at all, but move in a manner peculiar to themselves. Mr. Proctor ascertained with a great degree of accuracy that Beta, Gamma, Delta, Epsilon, and Zeta, the well-known group in the Great Bear, were all drifting at the same rate in the same direction, and now the recession of Sirius has been proved to be a fact. The cause of these movements is a mystery, but Mr. Proctor does not hesitate to apply in an extreme manner the experiences of Mr. Adams and Le Verrier (A.D. 1846) in regard to the discovery of Neptune. He inclines to the belief that there is in every instance a disturbing body, and in the case of Sirius this must be as large as that great star itself (much larger than the sun). It follows that if this companion body be a star we should see it. Mr. Proctor and some others, however, declare that such a body must exist, and that, as it cannot be seen, it is, therefore, a dark orb. This being the case, all that it is necessary to do to find its whereabouts is to conduct calculations similar to those of Adams and Le Verrier, and by such means ascertain the exact position of the dark companion orb. This has been done in other cases under similar conditions, but as yet without success. Mr. Proctor, however, thinks the principle is a sound one. If so, we have a peculiar state of affairs, viz., that not only are there stars scattered in myriads like diamond dust on the face of the heavens, but that, in addition, there are also thousands of dark stars that move with their glittering companions, but do not shine, and are not seen.

Considering (1) that Sirius's thwart motion long since indicated the presence of a companion, and that the position of the theoretical companion agreed fairly with a visible companion discovered by Alvan Clark; (2) that the calculations had not the least resemblance to those made by Le Verrier and Adams; (3) that the recession of Sirius was demonstrated a dozen years ago; (4) that *now* it is not the recession, but the surcease of recession, which is in question; and (to make a long story short) that I hold, and have expressed, not one of the opinions ascribed to me in the latter half of the above passage (but only that where there *is* a disturbing body the spectroscopic method may serve to indicate its presence), the paragraph may be described as first-rate for *news*. Unfortunately, there is more news than truth in it.

The new series of the *Cornhill Magazine* affords a melancholy example of the effect of putting new wine into an old bottle. The old bottle is burst,—the *Cornhill* of Thackeray and Leslie Stephen is "gone, positively gone." Very little has been left of the *Gentleman's Magazine*, under the new story-telling *régime*, but of the *Cornhill*, nothing at all remains except the cover. The illustrations of the Model Story would discredit the pages of *Bow Bells*.

THE FACE OF THE SKY.

From July 20 to August 3.

By F.R.A.S.

The usual watch should be kept on the sun on every clear day. The night sky will be found delineated in Map 7 of "The Stars in their Seasons." After the 22nd twilight will cease for an interval, gradually increasing every night. For all practical purposes there is not a single planet at present visible; nor will the moon occult any stars during the 14 days to which these notes refer. The moon's age at noon to-day is 15·9 days, and so on until August 2, when it will pretty evidently be 28·9 days at the same hour. At mid-day on August 3 it will be 0·4 day. Hence, after about July 26, she will be inconveniently placed for the ordinary observer. About midnight to-night (28th) she will cross from Capricornus into Aquarius. She will remain in this last-named constellation until noon on the 23rd, when she will travel into Pisces. She will occupy the next three days in traversing this constellation, which she will not leave until 3 p.m. on the 26th, passing then into Aries. About 7 a.m. on the 28th she will enter Taurus. About 7 p.m. on the 30th her path will carry her into the northern part of Orion. She will occupy some twelve hours in crossing this, and then emerge into Gemini. There she remains until midnight on August 1, when she travels into Cancer. She crosses this constellation during the 2nd and part of the 3rd, entering Leo about 4 p.m. on that day. We there leave her.

SOMETHING ABOUT THE BEET.

(*Continued from page 29.*)

The richness of the juice in the sugar is the greater as the juice is thicker; and the smaller-sized roots generally give the thickest, and therefore the richest juice. Still, this is not an absolute rule as yet, though we may some day show that it is.

The most satisfactory results are obtained with beets weighing 200 to 300 grms.; those weighing 300 to 400 grms. are a little inferior, and in all above this the percentage rapidly declines.

For every 100 kilos. of sugar there are from 13 to 14 kilos. of ash, consisting of alkaline and earthy phosphates taken up from the soil.

A substance which resembles *diastase* may be obtained from beet, but the examination of it at present is very incomplete.

The *Mammoth* variety appears to yield the largest crop, and the *Imperial* to yield the greatest percentage of sugar.

The specific gravity of seed taken immediately after gathering is a direct measure for ascertaining the amount of sugar present in the root, but as this is attended with a good many difficulties when employed for the purpose of choosing the roots for seed, the following is a better plan:—Cut pieces out of the roots about a third from the top, and place them in a bath of salt about 105°, and only those roots the cuttings from which sink should be used for seed.

Good seeds should have a germinating power of not less than 85 per cent.; this will depend in a great measure on the ripeness of the seed when gathered.

Germination begins between 6° and 7° C., and it takes about twenty days at this temperature to make them appear above ground. At less than 6° the growth is arrested to recommence again when the temperature rises. For this reason beets should be sown in April. In the beginning of the month the mid-day heat is alone useful, and, as it does not penetrate deep into the soil, the seeds should be sown shallow. They also require much moisture, and, if sown deep or too early, the tender shoots are unable to pierce the thick layer of earth which covers them.

Good results are obtained by steeping them in liquid stable manure for 48 hours, and afterwards gathering the seeds up in large heaps, and allowing them to heat sufficiently to start germination. In five or six days the radicules will appear, and the sowing should then be immediately proceeded with, and in less than a fortnight, if sown in the middle of April, there will be a well-grown crop of seedlings.

It is, on the whole, far better to plant sprouted seeds. They appear above ground sooner, and, besides the start which they get by doing so, it saves them from the insects which injure them when tender, a bottom layer of chemical manure, about ½ to 1½ cms. deep, helps their progress (a mètre = 39·37 English inches, and contains 100 cms., *i.e.*, centimètres.)

The choice of soil, manures, and other conditions for the growth of the beet are similar to those required for the potato, and as both require the avoidance of a late vegetation, no better instructions can be given for the beet than those followed for the potato.

I can but refer very briefly to the results of the manuring experiments, but as they are in most parts similar, as I said before, to those needed for the potato, this will, I hope, be excusable. But I have already taken up so much of the editor's space, that I am afraid he will be "hauling in the slack" if I do not stop very soon.

The French sugar manufacturers prohibit the use of nitrate of sodium among the growers of beet, presumably on account of beet absorbing such large quantities of nitrates from the soil. In fact, it is thought that the food of an animal kept on English beets manured with this salt would contain such an amount of nitre as would be really injurious!

It is better to apply artificial manure containing nitrogen-phosphates and potash in a soluble form shortly before the seed is sown.

Beets which contain the most sugar are poor in nitrates; hence nitrates decrease the yield of sugar.

There is a parasite called *Heterodera Schechtii*, which causes a failure in the crop; before this fact was discovered, the failure was put down to absence of potash and poorness in the soil.

The potash of charcoal residues is in a form which can be more readily absorbed by the beet than the potash of molasses beet. Phosphates and guano give very favourable results as regards the percentage of sugar in the yield. Lime from sugar works is better for the sugar manufacturer, as manure, than the mixture of lime with distillery residues.

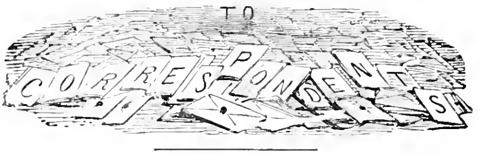
Avoid slow working manures, for it must always be borne in mind that all delays which prevent the plant from reaching its full growth are at the expense of the saccharine matter of the roots; they go on growing and taking up salts from the soil which they have not power to assimilate. Phosphates are most favourable when applied in the spring.

Stable-dung, when applied to the fields in the autumn, yields very good results both in quality and quantity. The use of phosphates, with Chili saltpetre, gave very favourable results—such good ones, in fact, that it is thought that farmers would do wrong to continue the use of nitrogenous manure alone. Two parts of Chili with three of superphosphate is a good mixture, but the best mixture of this must be deduced from future experiments, for which we must wait until we see the reports of the work now being carried on.

Another good mixture is 20 kilos. of phosphoric acid and 10 kilos. of nitrogen manure.

This, I hope, is enough new matter for the consideration of your readers, without my going into further details on this, at least to me, very interesting subject. F.C.S.

A CORRESPONDENT of the *Nebraska State Journal* writes: "I wish I could give you a description that would do justice to a railroad I rode on in Oregon. There used to be some coal-mines up at Coquille City, and a wooden tramway was run up from the head of Coos Bay. The mines gave out, but the tramway was left. I heard there was a railroad, and when I got there the train had backed up to the end of the track. Well, you would have died to see that train of cars. The old man who had appropriated the tramway had got an old engine out of the mine and mounted it on a hand-car, and connected the driving-shaft with the handle. This was the engine and tender. The baggage, mail and express cars, and the passenger coaches were comprised in two rubble cars, such as are used in the section for carrying tools, rails, &c. The old man was a no less wonderful combination than the train. He was the company and the working force of the road. President, vice-president, stockholders, agent, conductor, engineer, fireman, and peanut boy were all comprised in his lank form. He never had any trouble with the stockholders, and he carried the general office in his hat. My fellow passenger raised an umbrella when he got on board, and on my inquiry as to the need of an umbrella, said I had better raise mine—I would need it. When the train started I found out he was right. The puffing, wheezy old engine sent soot and water over us in a perfect shower. We got along, however, very well, and would have made the trip as quickly as we could have walked it, if the train had not stopped when we were about half way, and waited half-an-hour for a man who wanted to go with us to finish his supper."



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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FLIGHT OF MISSILES.

[874]—As to the westward deviation of a vertically discharged projectile caused by the rotation of the earth, Mr. Bray's investigation seems at first sight to be demonstrative, and, from its ability, thoroughly deserves to be so. Probably he has by this time discovered the deficiency therein. Let a mean always the place of discharge on the earth's surface, whatever position it may occupy in absolute space. We are on the equator, and η Virginis is in the zenith at the instant of discharge; so that our vertical at that instant is in the direction of $a\eta$. Now, Mr. Bray has taken into consideration only that the eastward angular movement of the vertical round a leaves $a\eta$ and the projectile to the westward; he has overlooked that this same movement brings the centre of the earth and the direction of gravitation to the westward of the downward prolongation of $a\eta$, and that therefore the projectile must be, at any time after discharge, not only west of the vertical, but, even more, westward of $a\eta$. I believe that he is better able than I am to complete his calculation by the introduction of this element.

If t be the whole time of flight, your formula for the deviation, ∂_h, of a projectile, due to the height attained and the time of flight, becomes $\partial_h = \frac{8\pi}{3} \frac{t}{P} h \cos\lambda$. It is quite easy to make out the formula for the deviation, ∂_r, due to the range attained and the time of flight, which is $\partial_r = 2\pi\frac{t}{P} r \sin\lambda$; the former deviation being always to the west, the latter in northern latitudes to the right. Substituting for h its value from the theory of parabolic trajectories, $\frac{v^2\sin^2\epsilon}{2g}$, and for r, $\frac{2v^2\sin\epsilon\cos\epsilon}{g}$ (v being velocity and ϵ elevation of discharge), we have $\partial_h : \partial_r :: \tan\epsilon : 3\tan\lambda$. Whence follows the interesting but not generally known result that in firing due N. in northern latitudes, when the two deviations are in opposite directions, if ϵ be selected so that $\tan\epsilon = 3\tan\lambda$, they will be equal and will annul each other. Thus, if the resistance of the air were absent, a shot fired N. from Westminster Bridge at the elevation of 75° 9′ would have no deviation from the rotation of the earth.

M. H. C.

BINOCULAR VISION.

[875]—My first letter having elicited comment, as I hoped, I beg to be allowed space for a few words in reply. I marvel much at some of the contents of Mr. Browning's criticism. Of course, I accept his statement of spectacles with unequal lenses being comfortably and satisfactorily used in a case of disparity of vision between the right and left eye of the wearer. But I take leave to observe that, in the case referred to, the linear disproportion (40 to 16) is only as 2½ to 1, whereas in my case (36 to 5) it is more than 7 to 1. No just parallel can, therefore, be drawn. As to the mistake with which he credits me, I remain unconvinced; he quotes my opinions as being that two "well-defined images of different dimensions will not coincide and coalesce"; whereas I used the word "immensely" before different, which is immensely different. The example which he gives of a penny and halfpenny seen in the "stereoscope" [misprinted "spectroscope"], is, similarly, not a case in point, the disproportion between the coins not being sufficiently marked. Had he made the experiment, say, with a crown

piece and a threepenny bit—well, I should have required rigid proof. Even as to the image midway between the size of the bronze coins, I don't quite see where the demonstration [Qy., explanation R. P.] comes in, or how it can be obtained.

Now, as regards Single Vision No. 2 and yourself, I am somewhat uncertain as to the precise fault found with me; and it would seem as if some definitions of terms were needed, for which I am, perhaps, responsible. I must therefore define that by "distinct dual vision," I did not mean distinct vision by both eyes in unison; but two distinct images, one with each eye; and further, that by "single vision" I mean one image, with one eye, exactly as if the other were closed or non-existent. With this explanation I distinctly re-affirm my proposition, adding that it is based on my own personal sensations and experience—inasmuch as, under certain conditions, and in a medium position, where the images formed in my two eyes are equally blurred and indistinct, I do, as a matter of fact, see two different images—of course, of equal size.

In conclusion, sir, permit me to remark that, as I have had a mathematical education, been assistant in an astronomical observatory, and aided theoretically and practically in calculating the radius of curvature for lenses, and grinding and polishing to correspond (in making object glasses for refracting telescopes), "Single Vision No. 2" has made a bad shot in assuming that optics are unfamiliar to SINGLE VISION.

[The difference between my own eyes is very nearly as great as between "Single Vision"'s, my left eye being very shortsighted indeed (I can see distinctly with it at a distance of two inches) while my left eye sees distant objects with perfect distinctness. Yet I see an object clearly and singly when the shortsightedness of the left eye is corrected by a suitable convex glass. Has "Single Vision No. 2" altogether missed? "Single Vision" seems to imagine the disproportion in size between the two images, when the sight of his shorter eye is corrected, is as 7 to 1 linear. If he will consider the matter, he will find, without having occasion to calculate curvatures or to grind or polish lenses, that no such difference exists; and that such difference as does exist, does not depend on the shortness or length of the sight of either eye—that is, it does not depend on the distances for distinct vision.—R. P.]

WARTS.

[876]—If you will allow me, I will add my experience—though fifty-five years ago—to what you have already inserted as to wart-charming. I enclose my card, for only private use, and I think the paper on which this is written may give a healthy colour to my veracity. My warts were counted exactly as described by "Puzzled Sceptic." Two or three were so small that, not being quite sure whether they were warts or not, they were *not* counted. The person said to be able to charm them away was a woman in the village in Yorkshire close to where I was born, and who had been my wet-nurse. At the time in question I might be about twelve years old. Having tried caustic, silk, and other household remedies unsuccessfully, I let her try. Whether, at that age, I had any belief in success I do not remember, but I am sure I did not trouble myself much about it. She said they would all be gone in three or four months. As a matter of fact, I have to state that by the end of that time the sole and only warts remaining were those which had not been counted, and had afterwards developed themselves. I have the mark of a very large one, which had two or three heads, upon one of my finger joints still. Being of an inquiring mind, I several times asked "Jane Watson" what she had done. For some time she refused to tell me. At last, being pressed by her "foster-son," she first extracted a promise from me (which I fear I have not kept) that I would not divulge her secret. Upon this she confided to me that she had taken a piece of worsted, and made as many knots in it as the warts that were counted. That she had buried it under a gooseberry bush in her garden, and, whilst doing so, that she uttered the following incantation, viz.:—

"Pray, Lord, as this rots and decays away,
To take Master Robert's warts away."

And now, having stated bare facts, I say no more. I know no more; but so it was. R. W. J.

Royal Institution, *June* 6.

[It seems likely that the charmer as well as the charmed should have full faith, in order that the right sort of mental influence may be produced. The effective action of the mind seems exerted while the counting is going on.—R. P.]

AN ENIGMA.

[877]—A very curious method of calculation for discovering any person's age having come under my observation, I think it sufficiently ingenious to be worthy of notice in your important paper. The system is as follows:—The person whose age you want to discover is requested to write down, privately, the day of the month he was born and the month of the year, then you ask him to multiply by two, add 5, multiply by 50, add *the age*, and subtract 365. You then ask him for the total, to which you add 115, and the result will show the day of the month, the month of the year, and the age.

The following is an example worked out. Supposing the person's age is 20, and he was born on the 5th of January—

```
              5,1
                2
             ----
              102
                5
             ----
              107
               50
             ----
            5,350
               20
             ----
            5,370
              365
             ----
            5,005
Then add—     115
             ----
           5,1,20
```

5th day, 1st month, 20 years of age.

Can any of your readers explain this, to me, strange arithmetical enigma? C. HOLLIS CHALLEN.

[Let us consider what you do with the numbers in question, and we shall probably find an interpretation of the puzzle. Let n be the number for the day, N for the month, A the age in years. Note next that multiplying by 2, adding 5, and then multiplying by 50, is the same as multiplying by 100 and adding 250; while subtracting 365, and then adding 115, is the same as subtracting 250; so that these four operations together are equivalent to multiplying by 100, or adding two cyphers to the number first taken, which is $10n + N$. As the only other operation is adding the age, it is not very wonderful that we get the three numbers we wanted,—provided always that N is not greater than 10, nor A than 100. Thus, if you take 3, 7, and 15, multiply 37 by 100, and add 15, you naturally get 3,715.—R.P.]

GINGER-BEER PLANT.

[878]—Perhaps some readers of KNOWLEDGE could help me by explaining the following facts:—

A member of our family, while out visiting lately, brought home what her friends called a "ginger-beer" plant. The plant (as we will call it) consists of numerous small bottle parts (separate) about the size of a pea, and somewhat resembling tapioca when it has been soaked. The mode of making the "ginger-beer" is to put a certain quantity of ginger (whole) into a good-sized bottle containing some of the "plant" and filled with water, and then to sweeten with a little sugar a short time before taking the "ginger-beer" out of the bottle.

During the *making* of the "ginger-beer," the plant shows strong effervescing powers (sometimes sending large pieces of ginger to the surface of the water).

The "plant" has to be separated every three weeks, by which time it will have doubled itself; and if not separated would burst the bottle, if the "ginger-beer" was not removed very frequently. The "ginger-beer" can be strained off about twice a day; and, although I have not tasted it myself, I am told it much resembles the bottled ginger-beer, but does not have the "gasey" taste which characterises the latter. T. H. PERRY.

INTELLIGENCE IN AN ANT.

[879]—I witnessed, the other afternoon, a very remarkable case of intelligence in an ant. I was sitting on some grass by the side of a small path, just in front of me being a short stone step, when my attention was drawn to two separate streams of ants, one going from me up the path, the other returning, carrying back with them their food. Among these little scavengers returning was one with a load much too heavy for him, so when the step was reached, over which all the ants had to pass, this busy worker dropped its burden, and then went over himself and got possession of it again. I expected he would proceed with the others, but instead of this he had a very laborious climb back again with the food, and then again dropped it over the step. The same thing was repeated three times, but at the third attempt I cut the piece of matter in two,

hiding one half, and watched to see if the former actions were repeated; but the ant, having now an easy load, followed the others, and was lost in the grass.

I came to the conclusion that the ant showed a great amount of reasoning power in dropping his load over the step so many times, as it was evidently his aim in doing so to break up his heavy burden, so that he might find locomotion easier with a smaller piece.

H'SETT.

LETTERS RECEIVED AND SHORT ANSWERS.

B. Y., Belfast. "The course of nature is perfectly invariable"—quite so; only what we want to determine in this matter is, just what that invariable course of nature may be. "Such things as 'Mrs. Croad's state' never ensue." The *Spectator* never said they "ensued"; possibly because the editor in the *Spectator* can write decent English. "Dr. Carpenter, mental matters regarded, is quite unreliable"; well, this is not the usual opinion; yet if it were, I should be disposed to rely considerably more on his opinion than on that of an obviously illiterate and illogical anonymous writer. Your last remark that "such statements must injure KNOWLEDGE, and if they do not, damn it, they ought to do so," sounds profane; but possibly there should have been no comma after "not"; if so, I must fain tell you, my dear sir, you resemble that friend of Artemus Ward's, who "coodn't panktooate wuth a cent."—AN OLD WOMAN. Thanks for your thoughtful letter. I think you overlook the circumstance that the forethought and care on which—as you truly say—the tenure of life depends, would themselves be regarded by the *Spectator* writer as part of "the policy" of Deity. The mental and moral qualities of men are as essentially natural gifts as their bodily characteristics. It could be shown—though I must confess it seems a hard saying—that the Sunderland catastrophe was, as you say, "the result of folly," still that folly and the ignorance, greed, and carelessness of which you speak, are no more to be blamed on those who, as you say, inherit these qualities than the children themselves were to be blamed for yielding to the law of gravity on that fatal stairway. In other words, all you say leaves the great mystery where it was.—CANES VENATICI. Thanks. But I fear the readers of KNOWLEDGE ought not to be provided with a picture and description of your 13½ in. Newtonian merely because "only a small dozen in Southampton know anything of science." Suppose the whole of that small dozen appeared in the Philharmonic Hall, and that as many as ten of them bought KNOWLEDGE on account of its being thus made "doubly acceptable," would the 1s. 8d. so received (the gross amount) go far towards the expense of drawing and engraving a photo of your 14 ft. Newtonian from a 6 in. by 4 in. photograph?—E. POWELL wishes to know where he can get a copy of General Pitt Rivers' book on "Spring Traps."—J. M. HARTINGTON. No; I can suggest no remedy for a "blotchy skin," supposing you have already tried regular living; but perhaps you have not. If so, there are still hopes for you.—AN ASHAMED SUBSCRIBER, U.S. If I could make out your object in writing, I should know why you are ashamed: as it is, I see no particular reason, except, perhaps, that you omit to send your name. Are you ashamed of *that?* The remedy is obvious. The verselets implying that God rules Nature are sound in thought, though in a literary sense feeble. But how they bear on anything in KNOWLEDGE, or why they should be inserted to tell readers what every one knows, passes *my* knowledge.—J. A. Nay, that would be asking the sellers of that article to advertise it here "free, gratis, for nothing."—E. WOOLLEY. Cannot give such details; they would occupy too much space, and be no news to most readers. Fear we are not likely soon to have space for the subjects you kindly suggest.—J. LAMBERT HALL. The error in last trick was not in proof. In note on trick 11, read for trick 11 trick 10, and for trick 12 trick 11.—G. JORDAN. I said that every month the moon is half the time north of the celestial equator. Will it remove your difficulties if I remark that for the other half she is south of the celestial equator? You ask, in particular, whether the moon ought not in Australia to rise and set in June to the north of east and west. By no means, if being full she is not too full and knows what is fitting for her to do. When the moon is full in June, she is, of course opposite the sun; and the sun being at his farthest north of the celestial equator, the moon is at that time at her farthest south of the same circle. Consequently her position is the same, or very nearly the same, as that of the sun in December, and naturally she rises and sets when full in June as he does in December, on the southward side of east and west in the southern hemisphere. I foresee that if I stop just here, you will ask how the moon can be seen in June in the Arctic regions if she is behaving thus in the southern skies, and should I fail to explain this, you will, I fear, rush incontinently to the flat earth theory, which seems to have such charms for you. Well, then, to start with, though the moon can be seen in the Arctic regions in June, she cannot be seen in June *when full*. If you will bring me a sailor (not too utterly full, or too foolish to remember what he has seen) who shall tell me that he has seen the full moon in June in the Arctic regions, then I shall be able to show you a full-fledged specimen of the genus "liar." In conclusion, let me inform you that the behaviour of the moon in any given latitude in the southern hemisphere is precisely the same as her behaviour in the same latitude in the northern hemisphere, only that what she does in January, February, March, April, May, June, July, August, September, October, November, and December in the northern hemisphere, she does in July, August, September, October, November, December, January, February, March, April, May, and June respectively, in the southern. Of this I needed no assurance before I had seen it for myself; but I have seen it for myself, so I know with the full assurance of eye-witnessing.—A. BARCLAY. Thanks; but your explanation, though sound, would not make the matter clear to that writer.—H. CLEMENTS. No space for planetary influences on weather. Try *English Mechanic*.—ELECTRICIAN. Thanks; but have at present no space.—FORGETFUL. Cannot say.—ISOBAR. The rainband spectroscope has been referred to in these pages. Klinkerfues' Weather Compass I have not yet seen.—W. DYER WARE, W. A. FELTON, and others. Cannot enter into details of that sort respecting Mr. Theobald's telescopes: it would form an inconvenient precedent.—JAS. MONTAGUE. Many thanks. But when mathematical problems were offered for solution such masses of MS. relating to them came in that it was impossible to deal with them. Consider the extra labour involved in deciding which solution is best among, perhaps, a hundred and thirty-nine.—R. E. W. Any bookseller would tell you who are the publishers of Sir G. Airy's treatise on the Hebrew Scriptures. I have the book, but am away from home.

SUB-EDITORIAL.

JAMES MENTEITH. For your "Newmoanier" a doctor would probably write an "inscription."—C. BOOTH. Such letters as yours do not reach the editor. He would probably not receive a very dreadful shock; still I prefer to act the part of an interposed buffer. "It is my duty and I will."—R. N. MELLIDEW, M. WILKINS, AN INQUIRER, SPIRIT WARNING, C. COLLINSON, RHYMING WILL, and many others. How *do* you suppose our editor chiefly employs his time? Or do you—perhaps—suppose he has nothing at all to do?

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

BY RICHARD A. PROCTOR.

PART VIII.

THE student must not always expect, however, to see so obvious a method of arriving at a maximum or minimum as in the preceding proposition. He must be ready to apply *tentative* methods. Take, for instance, the property established in the scholium to Ex. 8, and suppose we have the following problem:—

Ex. 10.—*Two points, P and Q (Fig. 15), lie on the same side of the line A B. It is required to find a point in A B such that the sum of its distances from P and Q shall be a minimum.*

We are supposed to know nothing of the property above mentioned. We should proceed, then, much as follows:—

Take the two points at very unequal distances from A B.* Draw P D, Q E perpendiculars on A B. Then it is very obvious that the point we seek is not likely to lie outside D E. In order to *see* the sums of lines to D and E, produce P D to F, making D F equal to D Q and P E to G, making E G equal to E Q. Then it is obvious from the figure that P F is greater than P G; so that E *may* be the point we seek, but D certainly is not. But let us try intermediate points. Take C_1, and draw P C_1 H, making C_1 H equal to C_1 Q. Then as drawn, P C_1 H seems certainly not less than P G. Take C_2 nearer to E, and draw P C_2 K, taking C_2 K equal to C_2 Q. We see that P K is obviously less than P G. Thus we learn that the point we seek lies between D and E, but nearer to E than to D. If we were not restricted as to the books of Euclid we were free to make use of, we might be tempted to guess that the point we seek might lie at distances from D and E, proportional to P D and E Q. This, indeed, would lead to the same result as we shall proceed to by another method. But we suppose the student limited to the use of Book I. He considers, then, what determinate point there can be in A B nearer to E than to D. He

* In problems on maxima and minima it is very important that inequalities of this sort should be sufficiently marked.

quickly rejects any points depending on the equi-division of the line. For instance, he cannot suppose that C E is *necessarily* a fourth part of D E; for since there is nothing to prevent P from being at the same distance as Q from A B, it is clearly not absolutely necessary that C E should be at all unequal to C D. The inequality

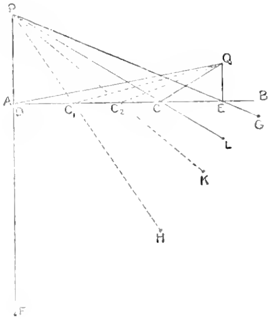


Fig. 15.

depends on the inequality of P D and Q E, and may naturally be supposed to vary with the extent of the latter inequality. Our student can hardly fail, we think, to light on the supposition that C ought to be so taken that the angles P C D and Q C E should be equal. He would try this, drawing now a new figure, as follows:—

Draw a line A B (Fig. 16), and from a point, C, in it draw C P and C Q, inclined at equal angles to A B, *and unequal*. Take another point, C_1, and join P C_1, C_1 Q. Produce P C, P C_1, to L and H, making C L, C_1 H, equal respectively to C Q, C_1 Q. Then we have to prove that P C_1 H is greater than P L.

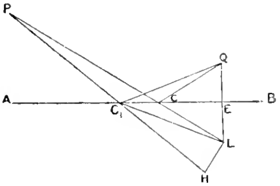


Fig. 16.

Join H L, then we should have to prove the angle P L H greater than the angle P H L. This does not seem very easy.

But next we notice that the angle L C E is equal to the vertical angle P C A (Euc. I. 15) and therefrom (*hyp.*) to Q C E. Also C L is equal to C Q and the triangle L C Q (here we draw in Q E L) is isosceles, C E being the bisector of the angle contained by the equal sides. Hence, C E is at right angles to Q L and bisects Q L in E. It is a very obvious consideration, at this point, that if we join C_1 L we shall have Q C_1 L an isosceles triangle, C_1 Q being clearly equal to C_1 L (Euc. I. 4). Hence, P C_1 and C_1 L together are equal to P C, and C_1 Q together. But P C_1, C_1 L together are greater than P L (Euc. I. 20). Hence P C_1 and C_1 Q are together greater than P C, C Q together. We find, then, that our surmise is correct, for what we have proved for P C_1, C_1 Q can be proved equally well wherever C_1 may be taken. Thus the problem is solved. It is not necessary to give the synthetical statement of our solution, since this has already been given in the scholium to Example 8.

It may be argued that such tentative processes as we began with, here, are not mathematics. To this it is to be answered—first, that the art of guessing well is an important aid to the mathematician; and secondly, that we deal with our guesses by means of mathematical reasoning, and thus gain all the benefit available from mathematical processes. But further, there are no *laws* for applying simple geometry—that is geometry resembling Euclid's—to deductions, and therefore in many cases we have no choice but to make use of tentative methods.

Our Whist Column.

BY "FIVE OF CLUBS."

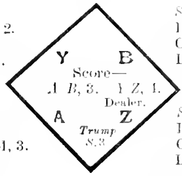
THE HANDS.

Y.

Spades—9, 4.
Hearts—A, 6, 5, 3, 2.
Clubs—10, 5.
Diamonds—K,9,5,3.

B.

Spades—A, Kn, 7, 5.
Hearts—Kn, 10, 8, 7.
Clubs—K, 6, 2.
Diamonds—Kn, 10.

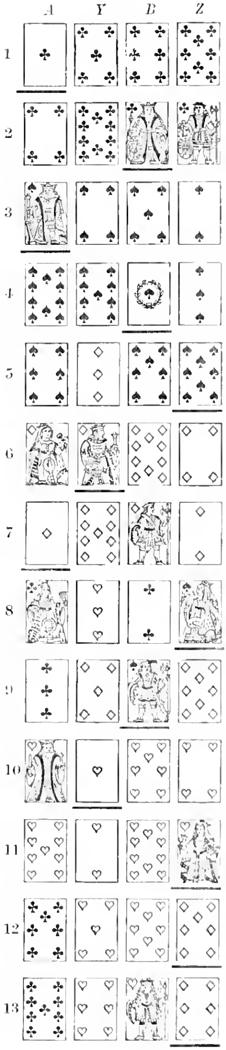


A.

Spades—K, 10, 6.
Hearts—K, 9.
Clubs—A, Q, 9, 7, 4, 3.
Diamonds—A, Q.

Z.

Spades—Q, 8, 3, 2.
Hearts—Q, 4.
Clubs—Kn, 8.
Diamonds—8, 7, 6, 4, 2.



NOTES ON THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. Neither 4, 3, nor 2 appearing, someone is signalling unless *A* holds all three.

2. *A* leads the ante-penultimate, showing he held originally six in the suit. *Y* and *Z* hold no more, and *B* has signalled. Both points should be clear to all; the second, with *A*'s indication of six in suit, showing that neither *Y* nor *Z* holds the Queen. Hence affairs look well for *A* and *B*, *A* having established his suit, of which *B* holds a small card to return with, and *B* having either one honour five trumps, or two honours four trumps. (*B* is scarcely justified in signalling.)

3 and 4. *B* had four trumps, two honours. *A* returned his highest (he cannot hold the knave), and has but one more at most. *B* knows that *Z* holds the Queen and one more, but *A* may hold the 8, in which case *B* can clear out trumps, and if *A* has a re-entering card the game is won. But as it is obvious that if *B* leads trumps he will not probably be able to return *A*'s Clubs, he should have done this at once, forcing *Z* effectually. Therefore

5. *B*'s lead of trumps here is very bad. *Z* of course wins with the eight, and has full command; but

6. *Z* does not draw *B*'s last trump, for he sees that if he does, any re-entering card either in *A*'s hand or *B*'s, would enable *A* to make his long Clubs. *Z* therefore takes the only chance of saving and winning the game, leading the penultimate card of his weak long suit.

7. *Y* deems it better to return his partner's suit than to lead his own, seeing the value his Heart Ace has, first as a re-entering card, and second in keeping the control of the Heart suit for the nonce. If the King is with the enemy, leading the Ace will free it and give them the game. Though having four Diamonds originally, *Y* rightly returns the best of two left.

9, 10, &c. The rest of the game plays itself. *Y Z* make the odd trick and the game, though *A B* held two by honours, seven trumps, three aces, three kings, two queens, three knaves, three tens, and two nines.

Our Chess Column.

By MEPHISTO.

Nuremberg, *July* 15, 1883.

WITHOUT being too sanguine, I think my previously expressed opinion has been confirmed by to-day's successful inauguration of the third congress of the West German Chess Association. The committee seem sincerely anxious to do everything in their power to render the sojourn of the players in this quaint old city as pleasant as possible. A very handsome suite of five large and lofty rooms, situated on the first floor of No. 1, Konigstrasse, has been secured for the meeting. The secretary and president, as well as the individual members of the committee, are very affable and friendly in their intercourse with the players, and altogether everyone is animated with pleasant excitement and a festive tone, a feeling that I, at least, never experienced on the fourth floor of the Criterion.

The entries, as will be seen, are more numerous than in the London tournament, and, putting aside the interest which is always attached to the play of Steinitz and Zukertort, I think on the whole more satisfactory.

The following nineteen players have entered the master tournament:—

Bird	London	Riemann	Germany
Blackburne	,,	Schottlander	,,
Gunsburg	,,	Löffmann	,,
Mason	,,	Schalloff	,,
Winawer	Warsaw	Bier	,,
L. Paulsen	Germany	Weiss	Austria
W. Paulsen	,,	Schwarz	,,
Bardeleben	,,	Hruby	,,
Lange	,,	Berger	,,
Fritz	,,		

Louis Paulsen needs no introduction; Weiss, Schwarz, and Hruby are very fine players; Weiss, having twice beaten Zukertort at Vienna, while Hruby has beaten English in a match. Of the names that might be new to English readers we mention Riemann, whose play is of a brilliant character. It will be remembered that Bardeleben won first prize in the London Minor Tournament. All the others are strong players. There are seven prizes in the master tournament, the first being £60.

A second tournament, with a first prize of £15, has also found favour among German chess players, no less than twenty-four having entered the lists, while a third tournament of sixteen is also being arranged.

In the chief tournament every competitor plays one game with another. Time limit is twenty moves per hour; the time of play is a severe trial to some who are fond of late to bed and late to rise. Play takes place at 8·30 to 12·30, and from 3 to 7. If possible, three games are to be played daily.

A problem tournament has also been held by the Association, and the winners will be declared at the occasion of a banquet to be held by the Association.

Play begins to morrow, and I think we may look forward to an exciting and interesting contest, which will produce some very fine play.

MEPHISTO.

SOLUTIONS.

END GAME OF J. ROBEY, p. 16.

1. Q to R4 (threatening to win the Q by Kt to B7 (ch), for which reason also Black cannot play R takes Q)

	1. P to Kt3 (*a*)
2. Kt to B7 (ch)	2. K to Kt2
3. Kt to R6 and wins. If Kt takes Kt, mate in two follows.	
(*a*)	1. P to R3
2. P to Kt6	2. P to B4
3. Kt to B7 (ch)	3. R takes Kt
4. P takes R and wins.	

PROBLEM NO. 86, BY C. PLANCK, p. 16.

1. Kt to B8	K to K4, or		P to K7
		2. Kt to Kt6 (ch)	K to K6
2. P to B5 (ch)	K takes Kt	(*a*)	
B to Kt4 mate		3. Kt to B5 mate	

(*a*) If 2. K takes P., 3. Kt to Kt6 mate. Or. 2. K to Q5., 3. Kt K6 mate.

PROBLEM NO. 87, BY J. C. S., p. 16.

1. R to Kt3	K takes P, or		P takes P
2. R to Kt6	P or K moves	2. Kt to K4	K takes Kt
3. R mates		3. B to B6 mate	
		If 2. K to B5	3. B to K6 mate

ENDING, p. 32.

This proposition is not quite sound, but the method of winning is as difficult to discover as the way to draw.

First 1. R to Kt4 (K to R6. 2. R to Kt sq., K to R7. 3. R to Kt4; in order, therefore, to win, Black must play) 1. P to R6.

2. R to Kt5 (If K to R8, 3. R to Q5, and White will draw by perpetual check).

	2. R to R3
3. K takes P	3. K to R8
4. K to B6	4. P to R7
5. K to B7	5. R to R7 (ch)

The right move to prevent the draw. The KtP must be abandoned, but in such a manner that Black should gain a move.

6. K to B6 (If 6. K to B8, R to R8 (ch). 7. K to B7, R to KKt8 and wins)

	6. R to R8
7. R takes P (The winning move)	7. R to B8 (ch)
8. K to K7	8. R to KKt8

(The K being forced away first, and now the Rook next, enables Black to win.)

9. R to KR6	9. K to Kt7
10. R to Kt6 (ch)	10. K to R6
11. R to R6 (ch)	11. K to Kt6
12. R to Kt6 (ch)	12. K to B and wins.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

K. W. SHERRARD.—Problem received with thanks.

BERROW.—See solution. If 3. Q to R6 (ch), Kt takes Q?

CONTENTS OF NO. 89.

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CONTENTS OF No. 91.

HOW TO GET STRONG.

REDUCING FAT.

(*Continued from page* 35.)

WE come next to the consideration of those methods of reducing fat which depend on quantity and quality of food.

So much attention has been directed of late to special forms of diet for the reduction of fat, that the comparatively less pleasant but not less effective method of diminishing the quantity of food taken, seems in danger of escaping due attention. In the system—really a very old one—with which Mr. Banting's name has been associated, the question of quantity is scarcely considered at all. Many meals may be taken each day, and at each meal much solid and liquid food, so long as certain prohibited articles are not touched. It is the same with other dietary systems. Now, there can be very little doubt that such systems have in them something of the mischievous character of medicinal methods. They depend in part for their action in reducing fat on the disturbance which they cause the troubled body. The absolute absence of certain articles of food to which we have been long accustomed causes something like a shock to the system, and through the distress caused by this shock there comes a sort of drain on the body as certainly as when we take exercise, but not as advantageously. Diminishing the quantity of food, both solid and liquid, taken daily, is at once safer and better. We may either reduce the number of meals, or the quantity taken at each, or effect the reduction in both ways, as may best suit the constitution. For most, the third system will be found to act best. One who has been accustomed to four meals a day may take three, without harm from the change. Where two cups of tea or coffee have been taken, and two glasses of water or of other liquids at a meal, a single cup and a single glass may be taken, the change being scarcely noticed at all. The solid food may be diminished at each meal by the omission of that last slice, or serving, or course, as the case may be, which changes satisfaction into repletion. In a day or two the change will have become a habit, and no inconvenience will be felt. I do not lay down, be it understood, the rules, When eating, leave off hungry, When drinking, leave off thirsty. There is a good deal of sound sense in what Charles Lamb said about these rules—that one might as well say, When washing to leave off dirty. But there can be no doubt that most of us continue both to eat and to drink, at meals, after the appetite is really satisfied.

The same carelessness—for the fault arises more from carelessness than from greediness—causes us to eat between meals, a most mischievous habit for all, except those few whose constitutions require that they should eat little and often.

Any one who pays attention to the matter for a few days, or until habits of sensible eating and drinking have been established, will be surprised to find how much of his daily supply has been altogether unnecessary, and can therefore be dispensed with. The extra meal, the extra platefuls and glassfuls at each meal, and the mischievous snacks between meals, which most of us take, would suffice for the whole day's food of a moderately abstemious man. The wonder is that more of us are not overweighted with fat. But Nature benevolently gives to most a power of disposing of more than we ought to take—though the power is used at the expense of the working energies. Those who have not the power are those who when they take more food than is good for them became overweighted with fat—not wholly the product of the extra food, but partly (and chiefly) resulting from the extra work put on the bodily organs by the unduly large supplies taken into the system. For fat is a proof among other things that the forces of the body have been overtaxed in such ways that the digestive organs, the circulation, the respiration, the excretory organs, have been unable to do their fair share of work.

Yet undoubtedly great good may be done by attending to the quality as well as to the quantity of the food. Those articles of food which certain mischievous and rather dangerous fat-reducing systems would dispense with altogether may most advantageously be reduced, and there are some articles of food which persons of corpulent tendency may altogether discard. Bantingism excludes beer, butter and sugar, bread, potatoes, and milk. Of these, beer alone should be absolutely excluded. Butter and sugar should be taken in very small quantities. Of bread, potatoes, and milk, the fat should take about half as much as they generally do. To many it is beneficial to go almost entirely without butter, milk, and saccharine food. The sudden disappearance of headaches, especially of the so-called bilious headaches, shows the benefit of the change. But it will not suit all. Bread and potatoes can be diminished in amount without any particular trouble. But potatoes should not be altogether excluded. They form an important item of food as food is taken in Europe and America. By taking one half of the quantity which has been usual with him, the fat man gets all the good he needs from potatoes, and avoids the mischief they have been doing him by adding to his fat. Taking tea without milk or sugar is pleasant enough, though the tea should then be weakened and cooled by the addition of a little cold water instead of milk. Coffee and cocoa without milk or sugar are medicine to most. But coffee and cocoa are not good for the corpulent, though they act mischievously in an indirect way only. All such wines as port, sherry, madeira, champagne, and sweet wines generally, are unsuitable for the obese. Claret is better; whiskey and water better still. But the less of any alcoholic stimulant taken the better. Best to take none. The control of the appetite, especially for flesh food, is much greater when no alcohol at all is taken into the

system. If the health suffers from going entirely without alcohol, then one tumbler of whiskey and water—at least three parts water, *per diem*—is all that should be taken. Even that should be reduced as the health improves.

Any one who, being corpulent, is unwilling to go without port, sherry, and other heavy wines, or without beer, or without undue draughts of spirits and water, need not read these articles. He must be one who has definitely decided that health and strength, lightness of spirits, as well as lightness of body, are not worth even a small sacrifice. He is as one who, knowing a cup contains poison ruinous to body and mind, drains it because the poison is diluted in a sweetly-tasted liquor.

I am aware, let me note in passing, that the advocates of special systems of diet for reducing fat, insist on a rigid adherence to certain rules, a rigid abstinence from certain articles of diet. They are right according to their lights. If we are to trust to Bantingism alone, for instance, to reduce fat, we must be rigid followers of the Banting system, we must take no potatoes and no bread, no beer and no milk, no butter and no sugar. And so of other systems. But if we are following a broader system, or rather a system of systems, we may take the good from each, and reject the bad.

Just here I may introduce a most important point, not noticed as yet, so far as I know, in any system for reducing corpulence. It is related closely to the question of quantity in food; but it is also related to that particular point on which, as I have said above, the development of corpulence in great part depends—the insufficient action of organs because of overwork. I refer to the proper mastication of food. We most of us eat a great deal too quickly, gulping down mouthfuls which have not received half or even a quarter of the amount of mastication due to them. From this gross fault two serious evils follow. We eat much more food than we should if we masticated all we ate properly, and the food we eat does us much less good than the right amount would do if properly masticated. We throw on the stomach much extra work, besides leaving some work undone which the stomach was never meant to do and is not competent to do. The overburdened stomach, consequently, leaves a part of its own work undone, so that the mischief is passed on to other organs, and the whole system is thrown out of gear. Let it be remembered as we eat that the teeth and the salivary glands have special work to do which they leave undone if we bolt our food. By making the jaws do their proper work, we make a smaller quantity of food supply our wants, and we send that smaller quantity to the stomach in a fit state for the stomach to work properly upon it. Hence a considerable saving of energy, and a corresponding reduction of those waste products which result in the formation of fat.

A lesser mistake, but still a noteworthy one, is to gulp down great draughts of liquid food, instead of quietly imbibing suitable quantities.

(*To be continued.*)

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XII.

The closing remarks in my last paper made reference to the terribly real form which belief in transformation assumed in the Middle Ages.

If wolves abounded, much more did the were-wolf abound. According to Olaus Magnus, the sufferings which the inhabitants of Prussia and neighbouring nations endured from wolves were trivial compared with the ravages wrought by men turned into wolves. On the feast of the Nativity, these monsters were said to assemble and then disperse in companies to kill and plunder. Attacking lonely houses, they devoured all the human beings and every other animal found therein. "They burst into the beer-cellars and there they empty the tuns of beer or mead, and pile up the empty casks one above another in the middle of the cellar, thus showing their difference from natural wolves." In Scandinavia it was believed that some men had a second skin, out of which they could slip and appear in the shape of a beast. Perhaps the phrase "to jump out of one's skin" is a relic of this notion. The Romans believed that the were-wolf simply effected the change by turning his skin inside out, hence the term "versipellis," or "skin-changer." So in mediæval times it was said that the wolf's skin was under the human, and the unhappy suspects were hacked and tortured for signs of such hairy growth. Sometimes the change was induced, it is said, by putting on a girdle of human skin round the waist; sometimes by the use of magical ointment. Whatever the animal whose shape a man took could do, that he could do, plus such power as he possessed in virtue of his manhood or acquired by sorcery, his eyes remaining as the only features by which he could be recognised. If he was not changed himself, some charm was wrought on the eyes of onlookers whereby they could see him only in the shape which he was supposed to assume. The genuine monomaniacs aided such an illusion. The poor demented one who conceived himself a dog or a wolf, who barked, and snapped, and foamed at the mouth, and bit savagely at the flesh of others, was soon clothed by a terror-stricken fancy in the skin of either brute, and believed to have the canine or lupine appetite in addition to his human cunning. The imagination thus projects in visible form the spectres of its creation; the eye in this, as in so much else, sees the thing for which it looks. Some solid foundation for the belief would, however, exist in the custom among warriors of dressing themselves in the skins of beasts to add to their ferocious appearance. And it was amidst such that the remarkable form of mania in Northern Europe known as the Berserkr rage ("bear-sark" or "bear-skin" wearer) arose. Working themselves by the aid of strong drink or drugs and contagious excitement into a frenzy, these freebooters of the Northland sallied forth to break the backbones and cleave the skulls of quiet folk and unwary travellers. As with flashing eyes and foaming mouth they yelled and danced, seemingly endowed with magic power to resist assault by sword or club, they aroused in the hysterically disposed a like madness, which led to terrible crimes, and which died away only as the killing of one's fellows became less the business of life.

During the fifteenth and sixteenth centuries, the belief in men-beasts reached its maximum, and met with no tender treatment at the hands of a Church whose Founder had manifested such soothing pity towards the "possessed" of Galilee and Judæa. That Church had a cut-and-dried explanation of the whole thing, and applied a sharp and pitiless remedy. If the devil, with countless myrmidons at his command, was "going to and fro in the earth, and walking up and down in it," what limit could be put to his ingenuity and arts? Could he not as easily change a man into a wolf or a bear, as a woman into a cat; and had not each secured this by a compact with him, the foe of God and His Church? The evidence in support of the one was as clear and cogent as in support of the other; hence were-wolf hunting and burning became as Christian a duty and as paying a profession as witch-smelling and

torturing. Any cruelty was justified by its perpetrators when the object in view was the vindication of the majesty of God; and not until the advancing intelligence of men recoiled against the popular explanations of witchcraft and lycanthropy were the laws against both repealed.

Those explanations were survivals of savage mental philosophy blended with a crude theology. To the savage, all diseases are the work of evil spirits. If a man hurts himself against a stone, the demon in the stone is the cause. If the man falls suddenly ill, writhes or shrieks in his pain, the spirit which has smuggled itself in with the food or the drink or the breath is twisting or tearing him; if he has a fit, the spirit has flung him; if he is in the frenzy of hysteria, the spirit within him is laughing in fiendish glee. And when the man suddenly loses his reason, goes, as people say, "out of his mind," acts and looks no longer like his former self, still more does this seem the work of an evil agent within him. It is kindred with the old belief that the sickly and ugly infant had been left in the cradle by the witch in place of the child which she had stolen before its baptism.* And the thing to do is to find some mode of conjuring or frightening or forcing the demon out of the man, just as it became a sacred duty to watch over the newly-born until the sign of the Cross had been made on its forehead, and the regenerating water sprinkled over it.

"Presbyter is but old priest writ large." And the theory of demoniacal agency was but the savage theory in a more elaborate guise. To theologians and jurists it was a sufficing explanation; it fitted in with the current notions of the government of the universe, and there was no need to frame any other. Body and mind were to them as separate entities, as they are to the savage and the ignorant. Each regarded the soul as independent of the body, and framed his theories of occasional absence therefrom accordingly. But science has taught us to know ourselves not as dual, but as one. She lays her finger on the subtle, intricate framework of man's nervous system, and finds in the derangement of this the secret of those delusions and illusions which have been so prolific in agony and suffering. She makes clear how the yielding to morbid tendencies can still foster delusions, which, if no longer the subject of pains and penalties in the body politic, are themselves ministers of vengeance in the body where they arise. And in the recognition of a fundamental unity between the physical and the mental, in the healthy working of the one as dependent on the wholesome care of the other, she finds not only the remedy against mental derangement and all forms of harmful excitement, but also the prevention which is better an cure.

The Luminosity of Heated Gases.—Dr. Werner Siemens has recently demonstrated, by means of his regenerative furnace, that highly heated gases do not emit light. The furnace employed was that of his brother, the glass manufacturer of Dresden, which gives a temperature of 1,500 deg. to 2,000 deg. Centigrade. The interior of the furnace was watched through sight-holes, and not the least light met the eye from the highly-heated air of the furnace. It therefore appears that all light from heated gas must come, not from the gas, but some solid radiating impurity. Observations with a thermo-pile also seem to show that no heat either is radiated by pure gases at a high temperature.—*Engineering.*

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* Spenser says:—

"Such, men do *changelings* call, so changed by fairies' theft."

SPOTS ON THE SUN.

By Richard A. Proctor.

Just now, when there are many spots on the sun, when new spots are continually forming, and when, in fine, that state of disturbance which is indicated by solar spots seems to be nearly at its height, it may be interesting to consider what the solar spots probably are, how they are generated, how they affect surrounding parts of the sun's surface, and how, after passing through the various stages of their existence, they come eventually to disappear. The inquiry is one of much difficulty, for the phenomena presented by spots are very complex and perplexing. We shall have to look at the subject from every available point of view, to see whether, by combining together all that is known either about the spots themselves or about phenomena related to them, we can determine their real nature.

In the first place, it will be well to consider what lies, probably, underneath the visible solar surface. We can then pass to the surface itself, thence to what lies outside that surface, until we reach the limits beyond which, so far as can be judged, we are not likely to obtain any information bearing directly on the solar spots.

Now, it is rather singular that the first direct information obtained by man respecting the sun's interior should have been derived from the study of the earth's crust beneath his feet.

Yet that has, in effect, been the case. The earth's crust tells us in unmistakable terms of tens of millions of years during which the sun has been at work pouring his rays of light and heat upon the earth as now—it may be in greater, it may be in smaller amount at one time or at another, but doing—which is all we need consider—an amount of sun-work corresponding to tens of millions of years' work at his present rate of emission of light-waves and heat-waves. Dr. Croll tells us, and Sir Charles Lyell adopted the statement as within the truth, that the earth's crust thus speaks unmistakably of at least one hundred millions of years of sun-work.

Now, the source of the solar light and heat is to be found in gravitation—that mysterious force which explained the mystery of the planetary movements, but presents in itself a far greater mystery. It explains also the mystery of light and heat which but for gravity would never have existed. The gathering-in of the sun's mass to its present volume, whatever that volume may be, generated the light and heat which the sun has emitted in the past, and the same process continuing will generate as the sun's volume continually diminishes the light and heat which doubtless he will continue to emit for many millions of years yet to come.

But if we measure the sun's volume, his mass being known, by the length of time during which he has been at work as at present, we find that, however vast we suppose the region of space to be throughout which his mass was formerly distributed, he must—judging from the work he has already done—have a volume very much less than he appears to have. For if he had gathered in his mass from a region of space practically infinite, until it was uniformly distributed throughout a volume such as the solar photosphere encloses, the heat resulting from this process of formation would not be equivalent to more than some twenty millions of years' supply of heat at the present rate of emission. But the earth alone tells us of at least one hundred millions of years of such emission of heat. Now, I think we may safely set aside Dr. Croll's explanation that the sun's heat might in part have been derived from the

collision of bodies travelling already through interstellar space with enormous velocity; for when we rightly apprehend the vastness of such space we see that collisions of those bodies could no more occur with the necessary frequency than the bullets fired by two widely-scattered bodies of skirmishers could be continually encountering in mid-space. We seem forced to the conclusion that the work of solar condensation has gone on much farther than it seems to have done—in other words, that the sun's real globe is very much smaller than that globe, bounded by the photosphere, which is actually seen by us.

According to this view, the real surface of the sun would lie tens, possibly hundreds, of thousands of miles below the photosphere—far below even the lowest of those lower levels disclosed in the larger sun-spots.

That this view is correct is shown in other ways. If we consider how the sun-spots shift in relative position, through what is called their proper motion, we cannot but infer that the cloud-laden region in which they are formed lies very far from the real surface of the sun. The spots are limited, as every reader no doubt knows, to two zones of the solar photosphere corresponding to the sub-tropical and temperate zones on the surface of the earth. Those which lie nearest to the equator indicate a rate of rotation, in the equatorial zone of the visible surface, carrying it round once in about twenty-four days. Those which lie farthest from the equator indicate a rotation period for these parts of the spot zones, carrying them round once in about twenty-four days. Now, if we assign to the equatorial zone an area equal to a tenth of the sun's, we have a surface exceeding the earth's 1,200 times. To each of the zones of slowest motion (leaving the Polar regions out of consideration altogether) we may assign half this area, or to the two combined the same area. The depth of the cloud-laden region in which the spots are found averages certainly not less than 8,000 miles—or say a diameter of this earth. The volume, then, of the equatorial zone of cloud-laden matter, which rotates once in twenty-four days, is certainly not less than 2,300 times the volume of the earth.* This also is the sum of the volumes of the two spot zones farthest from the equator, which rotate once in twenty-eight days. If these regions were of the same mean density as the sun, or about one-fourth the earth's, then the mass of the equatorial region would be about 600 times the mass of the earth, or nearly twice the mass of the giant planet Jupiter—and each of the zones remotest from the equator would nearly equal Jupiter in mass. Now, it is utterly impossible that such masses if forming part of a continuous atmospheric cloud-laden region, and not very far indeed from the surface of any solid, liquid, or highly-compressed vaporous nucleus the sun may have, should be free to travel round at rates so different, that the equatorial region is carried round seven times while the two farther spot zones are carried round only six times, the former gaining one rotation—a circuit of two million miles—on the latter in 168 days, or nearly 500 miles per hour. Frictional resistance would undoubtedly coerce the various zones of the sun's surface to the same rotation rate. The cloud-laden region in which the spots appear must, therefore, be very much rarer than the sun's real globe, and the sun's real surface must lie far below the visible surface.

* It may be divided into 1,200 cubes (approximately enough) each a terrestrial diameter in the edge, each therefore exceeding the earth in volume in the same degree that a cube exceeds the inclosed sphere, or as 6 exceeds π. Putting π at 22/7, this gives the ratio, 21 to 11, in which 1,200 must be increased, giving 2,300 approximately.

There is another proof of the same important fact. It has been shown by Professor George Darwin that if the central parts of the sun were not very much denser than the rest, the sun's globe would be measurably compressed at the Poles. Now there is nothing more certain than that no such compression can be recognised. The meridional observations of the sun at all the great national observatories are now to be counted by hundreds of thousands, and they are all (practically) measurements of the sun's disc. If there were measureable compression, it would be recognised among this vast collection of measurements. But they agree in showing no trace of measurable compression. It follows that the sun's central portion is much more condensed than parts near his visible surface, a result agreeing with what we have already inferred from two lines of reasoning, each nearly amounting to a demonstration.

We conclude, then, that the real surface, where in all probability the disturbances arise to which sun-spots are due, lies tens of thousands, possibly hundreds of thousands, below the visible surface, where the effects of those disturbances are recognised.

(To be continued.)

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. II.

SEVERAL of the constituents of the various grains with whose chemistry we are now dealing are so much alike that it is difficult to determine whether it is better to first finish what we have to say about one of these bodies and then go on to the others, or to commence by giving an outline of the properties of the whole, and subsequently deal with them in detail. Thus starch, cellulose, and the gum of the various cereals are identical in chemical composition, and in many respects are most closely allied to one another. It will probably render our work simpler if we at any rate study these three bodies together. Our last article will have made the reader acquainted with the general properties and appearance of starch; we would now direct his attention to the next member of our present group—viz., cellulose. The percentage of this body present in grains varies from 1·0 in oats to 14·9 in maize. A passing reference was made to it in our last paper, where it was stated that the outer envelope of the starch granules consisted of starch cellulose. The function of this body in plants is somewhat analogous to those of the skeleton and connective tissue in animals. Not only are the envelopes of the various cells of the plant composed of it, but also woody fibre and the more solid framework of plants consist of this compound. In physical properties cellulose differs widely: the pith of elder, linen, cotton wool, and some of the specially prepared paper used by the chemist for filtering purposes are nearly pure forms of cellulose. On the other hand, it occurs in an approximately pure state in the "tagua-nut," a substance so hard as to be capable of being turned in a lathe and having every appearance of ivory.

Cellulose, like starch, is represented by the chemical formula $C_6H_{10}O_5$, and is very probably derived in the plant from starch. One of the greatest wonders of organic chemistry is this fact of there being many substances of widely different appearance and properties, and yet of the same formula. Cellulose and starch are two cases in point, and to these we may add a third in dextrin, or "British

gum." Here, then, are three bodies, in many respects widely different from each other, and yet apparently alike from a chemical point of view. Supposing they were subjected to analysis, the result in each case would be carbon 44·45, hydrogen 6·17, and oxygen 49·38 per cent.; from these results the chemist would for each calculate as the simplest formula that just given above. In many cases he can further state with certainty that the molecule or ultimate group of atoms of each compound contains only the number of atoms represented by this simple formula; but in other instances he finds with equal certainty that the formula must be doubled. To make this clear by an example, the calculated formula of oxalic acid is HCO_2; other considerations, however, leave no doubt that the molecule actually contains $H_2C_2O_4$. We are here presuming that it is self-evident that, whichever be the formula, the percentage composition would be identical. It is not so easy to say with starch and these other bodies whether their formulæ are multiples or not of that above given. It is very probable that they are such multiples.

This much we know, that there are not only widely different chemical compounds whose formulæ only differ by being multiples of each other, but there are also others whose formulæ are actually identical, notwithstanding the very opposite characters they may present. In endeavouring to trace out the cause of this we must look to some different arrangement of the atoms within the molecule. The chemical elements and the chemical compounds may be aptly compared to the letters and words of a language; just as out of twenty-six letters, millions of word combinations are possible, so with our few chemical elements an infinity of chemical compounds may be produced. We know, further, that out of the same letters, differently arranged, we may form several words; thus the letters a, r, t give us respectively the words, art, rat, and tar; so in a similar manner may we suppose that different groupings of the atoms within a molecule may yield a variety of chemical compounds. Modern chemical research has gone a step further than this, and in many instances tells us exactly how the molecules are grouped together in the compound, and what the difference in grouping is that causes two bodies of similar percentage composition to vary so much in character.

Cellulose is white, tasteless, and insoluble in water; it may, however, be dissolved by a solution of copper oxide in ammonia, and can again be precipitated by the addition of hydrochloric acid. Starch and cellulose may be readily distinguished from each other by the addition of iodine; the latter compound remains colourless, or, at most, is stained slightly yellow. Starch, on the contrary, becomes an intense blue, so dark with much iodine as to appear black. This test is a most important one for starch, and may frequently be used in every day life for its recognition. It may be employed in the following manner:—Make a dilute solution of iodine in methylated spirits, or dilute the pharmaceutical tincture of iodine with spirits, until of a deep sherry tint; the re-agent is now ready for use. Make a solution of starch and add the iodine solution, notice the intense blue colour produced; on boiling the liquid the colour vanishes, but reappears on cooling. This test may be used for determining which are the starch-cells in microscopic sections of wood, &c., for on moistening the specimen with a very dilute iodine solution, the starch granules become blue. The uses of cellulose in the forms of cotton, linen, and paper are familiar to all.

Let us in the next place see what relation starch and cellulose bear to the gummy matter of the cereals. In our series of analyses, quoted in the former article, gum and sugar are classed together. The amount present varies from 1·6 in rice to 11·3 per cent. in rye; wheat is intermediate, with a percentage of 3·8. It has been already stated that this particular form of gum also has the formula $C_6H_5O_{10}$. From its powerful action on polarised light, it has received the name of "dextrin." The optical behaviour of dextrin and its allied bodies will furnish ample subject-matter for a separate article of the series. Starch and cellulose, if subjected to heat, become altered in character. This is more particularly seen with starch. By heating starch or flour to a temperature of about 150° C., it is found to undergo a slow change; it darkens in colour and acquires the odour of highly-baked bread. On now treating with water, a substance is dissolved out, which possesses all the most important properties of gum arabic; on evaporation, we have dextrin remaining as an uncrystallisable, solid, and translucent body. Dextrin is applied to a variety of useful purposes, among others the stiffening of calicoes, in which instance it is used as a substitute for its allied compound, cotton cellulose. Notwithstanding the intimate relationship of these two bodies, the substitution of dextrin is not altogether to be recommended, for although the material may look well in the hands of the shopman, the soluble dextrin, after the first washing, manages to avoid taking its share of the fair wear and tear of the article. Dextrin is also used for producing the adhesive layer on the back of postage-stamps. It is said to have been first discovered at the burning of a starch manufactory. One of the firemen, worn out by the exertions of extinguishing the fire, lay down in his garments, wetted by the water that had drained from the heated starch, and awoke to find himself firmly glued down to his resting-place. The production of dextrin, from starch by heat, was thus first noticed, and gave rise to its further manufacture. Should this account be the true one, many readers may see an analogy to the Chinese discovery of roast pork, by the accidental burning of a pig-stye; while rumour has it that the Chinese for some time burnt a pig-stye whenever they wanted roast pork—it is *not* the custom of English manufacturers to burn starch factories for the purpose of maintaining the supply of dextrin. [Charles Lamb, in his famous essay on Roast Pork, says a *house* was burnt to supply roast pork in the early stages of men's faith in that edible. I may note also that the account given in Dublin of the origin of the manufacture of the postal gum differs considerably from that given above. A whiskey store, not a starch manufactory, appears, and the national potato (introduced, as is well known, by St. Patrick, when he came over from his native city Glasgow for the purpose of driving out snakes from Ireland) plays an important part in the story.—R. P.]

THE GREAT PYRAMID.

MISS A. B. EDWARDS AND MR. R. A. PROCTOR.

[I have received the following letter from Miss A. B. Edwards, with permission to publish, of which I gladly avail myself.]

YOU have lately replied in the pages of KNOWLEDGE to certain correspondents who have reminded you that Egyptologists in general regard the Great Pyramid as a tomb only. I am, as you know, one of that number; but I, nevertheless, gladly take this opportunity of repeating that some of your views as to the astronomical purposes fulfilled at certain stages of its erection, seem to me not only sound and probable, but proved beyond further question. Your theory of the use and purpose of the water-

chamber, and of the ascending and descending passages, as tubes through which to obtain the reflection of the rays of Draconis, offers the only rational explanation of these parts of the structure with which I am acquainted; and your exposition of the purpose of the great gallery—which, as it now exists in the heart of the structure, ending against a dead wall, is entirely without object or use—appears to me absolutely irrefragible.

That the Great Pyramid was, in even a secondary sense, erected *in order* to obtain an astronomical platform and an observing tube, is what I cannot subscribe to; but given that the Pharaoh built his monster tomb during his lifetime, I can fully admit the likelihood of its having been made use of, during its progress, for purposes of astronomical or astrological observation.

Amelia B. Edwards.

[I think my correspondents referred chiefly to remarks by some continental Egyptologists; but as Miss Edwards had expressed the same views in her very kindly notice of my book on the Great Pyramid, it is probable that several of them referred to her known views on the subject. It appears to me that most Egyptologists fail to estimate the significance of the astronomical relations involved in the Pyramids, and especially in the Great Pyramid. What Miss Edwards, for instance, regards as proved beyond further question, carries with it a great deal which she appears to regard as more than improbable. I will run briefly through the considerations which seem, to my own mind, logically convincing in this respect:—

Either the Egyptian rulers were greatly interested in the advance of astronomical and astrological learning for its own sake, or they were not. If they were *not*, it would be very unlikely that merely for the sake of such astronomical purposes as the structure might subserve at certain stages of its erection, they would have gone to the enormous extra expense, labour, and care involved in the construction of the great slant gallery. If, on the other hand, they *were* greatly interested in the advance of astronomy, it would be manifest to persons as familiar as they obviously were with astronomical relations, that little of real importance could be added to their knowledge by an observing gallery only available for a few years; they would have recognised the absolute necessity, if they would effectively advance their science, of an observatory so constructed as to be available for centuries. Seeing, then, that whether the Egyptians were, or were not, greatly interested in the advance of astronomy, they would never, for *that* purpose, have given to the Great Pyramid the qualities as an observatory which *were* actually given it at the cost of enormous extra labour, care, and cost, it follows *certainly* that the astronomical and astrological relations considered by the builders were other than those merely connected with the advance of their science—were, in fact, such as made it worth their while to devote all that skill which they evidently possessed, to employ all that extra labour and to go to all that extra expense of which the building gives evidence, for astronomical and astrological relations which *would*, in their belief, be effectively advanced during the few years that the great platform and gallery could be used for observing purposes. I can see no escape, for my own part, from the conclusion that these astronomical and astrological matters related solely to the king for whom the Great Pyramid was erected. In other words, it appears to me a demonstrated fact (whatever the interpretation of the fact may be) that while the ultimate purpose of the Great Pyramid was that it should serve as a tomb for Cheops, its primary purpose (not a secondary purpose at all) was that by means of it those observations of celestial bodies, which, according to the belief of his time, were essential for his success in life and (I have no doubt) for his welfare after death, should be satisfactorily and effectively pursued. If there is any way of escape from this conclusion, I have not seen it, nor has any Egyptologist who has ever asserted that the Great Pyramid was a tomb and a tomb only, ever indicated one. Lepsius, of all among them, took, I think, the most logical position,—in regarding astronomical evidence as not worth considering at all. In so doing, he only rejected a demonstrated fact. But to accept that fact, and not to accept what it proves, is to be wanting in the logical completeness of unreasonableness which Lepsius showed in this matter.

Indeed, the tomb theory taken alone proves a good deal which those who hold it seem to overlook. In concluding that the Great Pyramid was a great tomb, we are admitting that its erection was closely and intimately associated with the religious ideas prevalent among the ancient Egyptians when it was built. From all the indications which have reached us as to the nature of those ideas, it might be shown, I believe, even though nothing whatever were known of the Great Pyramid, except that it was very large and had been erected at such-and-such cost of time and labour, that during the lifetime of its future tenant it must have had some such astronomical characteristics as is actually possessed. If sun and moon and planets were the gods of the ancient Egyptians, and the star sphere the house in whose "many mansions" those gods moved—and there are abundant indications that such was the nature of the most ancient Egyptian cult—the aspects of the heavenly bodies were bound to be considered during life and after death in the case of every Egyptian "worth counting" (I suppose the "common-folk" were not considered worth counting at all), more particularly in the case of governors, generals, official rulers, and priests, still more particularly in the case of princes and members of the royal family, but most particularly of all in the case of him who was at once King, Prime Minister, Chief General, and Highest Priest. Knowing what we know, and inferring what we may safely infer, of the religion of Old Egypt, the wonder would rather have been that astronomical and astrological relations should *not* have been considered in the Great Pyramid—being what it was, the future resting-place of the greatest of their nation—than that we should find these relations considered so thoughtfully and so skilfully, with so much care, at such great cost, and at the expense of so much labour.—R. P.]

PRINCIPLES OF DRESS REFORM.

By E. M. King.

"Mere novelty, divorced from the 'eternal canons of loveliness,' as Ruskin calls them, can produce only oddity of various kinds, as we see in the world of fashion, where a morbid love of change is always at hand to usurp the throne of reason, and to juggle Nature out of her most comely graces and most healthy proprieties."—*Professor Blackie's article in "Contemporary Review" for June,* 1883.

"Utility, and fitness to attain a practical end, must be as in all the useful arts; but it is there as a basis on which the beautiful is erected, or as a stem out of which it grows." —*The same.*

"There are two sides to the artistic view of the question (dress). On one side is nature; on the other art. I need go no further than to remind your readers that the human frame, if in its unsullied grandeur, is, of all the Creator's works, the most artistic. Consequently, I contend that

the dress which best adapts itself to the form and requirements of that frame has the best right to be considered artistic. The mind of man has discovered for himself a dress which, I hold, fulfils both these requisites. It remains to be seen whether the mind of woman is equal to the task of devising a similar one for herself."—*Letter by Clavering Mesnard, in* Knowledge *of June* 29.

"Women now will have to be content to wait before art (in dress) in any true sense of the term can be theirs. They have so distorted and disguised nature that art for the present is impossible. We must wait and gain a correct and right appreciation of nature before we can have any true art. Before we attempt to decorate, let us have some veneration for the divine temple of our bodies which now, while ignorantly seeking to adorn, we only desecrate. And while we are waiting and learning this great lesson, a truer beauty will arise compatible with use and fitness, and women become reformed not in dress only but in mind and character."—*Pamphlet by E. M. King.*

"Men are very near towards gaining beauty and grace in their dress, they having already secured, in a very great degree, the more essential requisites of comfort and convenience. Women, on the contrary, having sought only beauty and grace in their dress, and neglected the essentials of comfort and convenience, have, in reality, failed to secure either. Men's dress is only negatively ugly, but women's dress is positively ugly. It is not only ugly in itself, but it insists upon making the body which it covers ugly—that is, deformed. But, unfortunately, our eyes are holden that we cannot perceive this ugliness, custom having long familiarised our sight to it, and because it has been disguised by always being decked out in beautiful colours, to which it has no claim. And so it is that, for men's dress to conform to right principles, very little alteration is required; while, for women's dress to be made to answer to them, such a wide measure of reform is called for that it amounts almost to a revolution."—*Lecture by the same.*

These four passages agree on the following points:—That the foundation or basis of beauty in any useful art must be utility or fitness. That the source of beauty in art lies in the study and appreciation of Nature. That dress, being one of the useful arts, must have its basis in use and fitness; and its beauty, growing out of this as out of a stem, must be derived from a correct appreciation of the human form. That the dress which answers to the requirements of the body, and best adapts itself to the form, is at once the most useful and the most beautiful dress. That men's dress, being closely adapted to the form of the body and its requirements, is the most beautiful. That women's dress, as having little regard to use or fitness, and not adapted to the form of the body, does not possess beauty. That Fashion, which in women has usurped the throne of Reason, can never give us a dress at once useful and beautiful. That if the mind of woman is ever to become equal to the task of devising for herself a dress adapted to the form of her body and its requirements, she must dethrone the usurper Fashion which has implanted in her mind a morbid desire for change and juggled her out of the most comely graces of nature and of its most healthful proprieties, and must substitute for it the guidance of Reason and right principles. That the change required in women's minds, feelings, and habits, in order to substitute the guidance of reason for that of fashion, is so great as to amount almost to a revolution.

I have here endeavoured to put together the opinions of two men writers with those of my own, to show how far these agree with mine, and also to show that if these are correct, nothing short of a revolution can effect the change we desire.

The change from the external despotism of fashion to that of self-government of reason and right principles, is a revolution.

The change from unfitness and ugliness to suitableness and beauty is a revolution. To effect this twofold revolution the inward or mental, and the outward or practical must work together hand in hand or both remain abortive. To call in the despot Fashion to introduce a change, however practically beneficial, is useless. To believe in and subscribe to right principles without power or courage to carry them into practice is also useless.

In order to form a basis of mental self-government in dress, I have drawn up the following principles or requirements of a perfect dress. They may or may not be entirely feasible; they may or may not be altogether correct; they may be insufficient, or they may be redundant; but they are an attempt to dethrone the usurper Fashion, and to raise in its stead the guidance of reason. The requirements of a perfect dress are: 1. Freedom of movement. 2. Absence of pressure over any part of the body. 3. No more weight than is necessary for warmth, and both warmth and weight equally distributed. 4. Grace and beauty combined with comfort and convenience.

But it has before been proved that dress, to be both useful and beautiful, must be adapted to the form of the body and to its requirements; therefore, in practically carrying out the foregoing principles, clothing must follow, and drapery not contradict, the natural lines of the body. In effecting any radical change we must be careful so to bring it about as not to put ourselves, or to induce others to put themselves, too much out of harmony with our or their surroundings.

This brings me to my fifth requirement, upon which I specially desired to write, which is that it must (5) not depart from the ordinary dress of the time. I found it, however, impossible satisfactorily to discuss this point until I had clearly marked out the road we have to follow.

It may be doubted whether "the mind of man" had very much to do in bringing about the change in men's dress from a highly-decorated one to an extremely and, I may say, an over-plain one. It is more likely to have been produced by men's love of comfort and a sort of can't-be-bothered feeling, rather than by any conscious mental effort.

The task which women have before them is a far harder one than that which men had to encounter, because we have to work up through the prejudices and conventional ideas of the other sex as well as our own, and to do battle with the accumulated power and influence of various trades—an influence which seems to extend every year; for now the tailors have got hold of us as well as dressmakers, drapers, and manufacturers, all ready to rack or wreck our bodies and souls so that they may but fill their own purses; while the unreasoning and illogical male multitude tacitly back them up, looking on us as, in a measure, fair game, as a sort of *corpus vile*, which it does not much matter if fashion works its deforming and degrading experiments upon, because, forsooth, "spending is good for trade."

(To be continued.)

Gold Production in Russia.—According to a report drawn up by Mr. Irvanow, the production of gold in Russia during the year 1882 amounted to 57 million roubles (8½ millions sterling). Russia thus stands next to North America, which produces annually about 9 millions sterling, while Australia follows with 7½ millions.

THE MOON IN A THREE-INCH TELESCOPE.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

ERATOSTHENES (110), of which we spoke on p. 391 of Vol. III. as terminating the magnificent chain of the Lunar Appenines, presents a beautiful spectacle about the ninth day of the moon's age. Our drawing was made

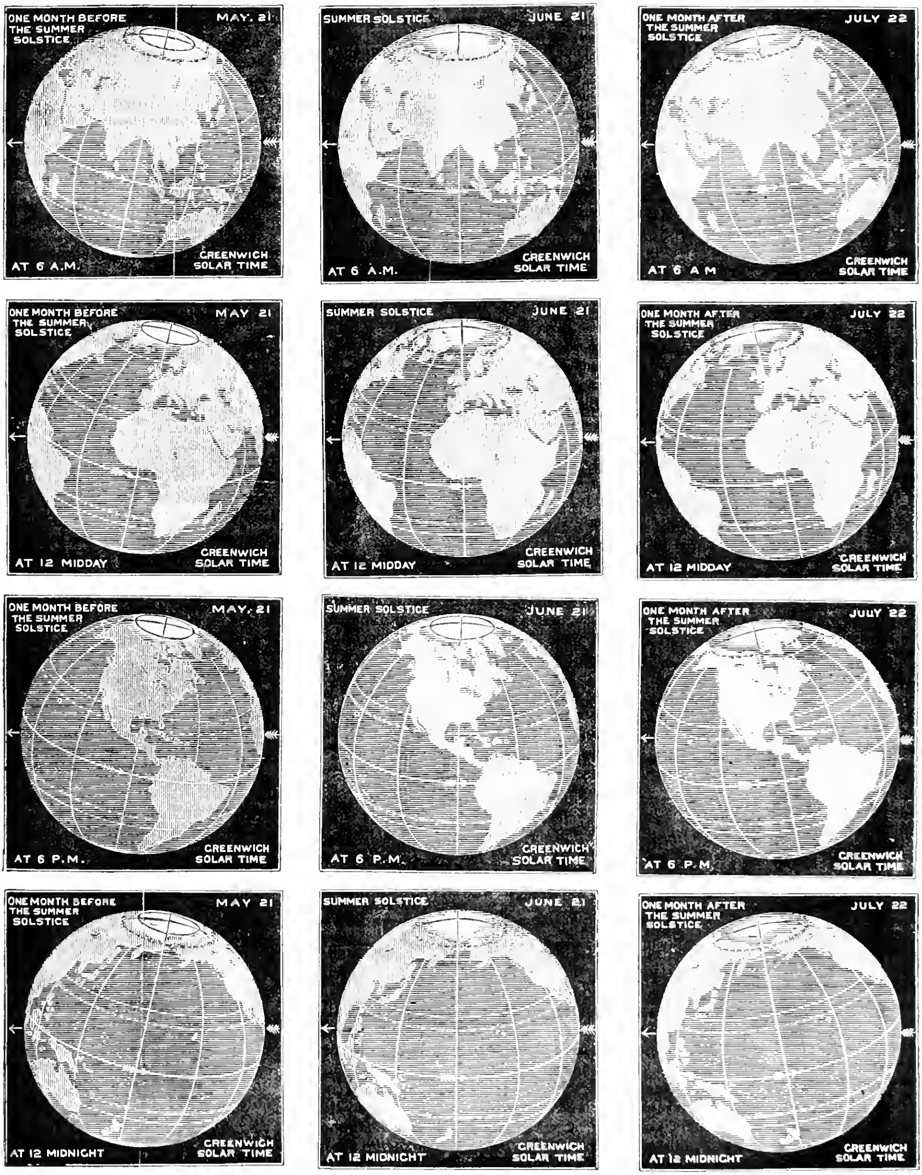
Eratosthenes. Moon's Age, 9·23 days.

with a power of 160, when the moon's age was 9·23 days. The diameter of this finely-terraced formation is about 37½ miles, and its walls will be seen to be very rugged. The three central peaks, too, are conspicuously shown under this illumination. It is curious that a formation presenting such strongly-marked features when lighted obliquely by the rising or setting sun, should be by no means easy to find at full moon. South-east of Eratosthenes will be noted a deep mountain range, terminating in a ring-plain whose walls are only some 130 ft. or so high. Hence it is only visible during a short period of favourable illumination, and forms a very severe test of the defining power of a 3-in. telescope, and of the keenness of the observer's vision. The height of the connecting ridge of mountains is some 4,470 ft. As Ben Nevis is 4,406 ft., and Snowdon only 3,571 ft. high, this may suffice to furnish a scale whereby the student may estimate the dimensions of the leading features of this neighbourhood. Schroter (106), or rather its northern vicinity, should be carefully looked at when near to the terminator, for the strange system of ramparts sloping off on either side of a central one, which Gruithuisen believed to be artificial, but which in reality consists of a series of parallel valleys. Parry (217), Bonpland (218), and Fra Mauro (219), are those more or less imperfect ring-plains which present a curious appearance when pretty near the terminator. Pitatus (186) and Hesiod (187) are a pair of huge craters, or rather ring-plains, connected by a pass. The northern wall of the former will be seen to be imperfect, while the southern wall is separated from Tycho, which we are immediately to examine, by a rugged mass of mountain peaks. The two most notable peculiarities in Hesiod are a central crater in the floor, and a cleft (shown in our map) running into the Sea of Clouds. And now we arrive at what has been aptly called by Mr. Webb, "the metropolitan crater of the moon," Tycho (180), reference to the system of streaks emanating from which has been once or twice previously made. This splendid formation, visible as a white spot to the naked eye at full moon, measures fifty-four and a quarter miles across, and xhibits an elaborately terraced wall, some 16,000 ft high on the east side and upwards of 17,000 ft. in height in its western portion. In the subjoined sketch we have purposely abstained from any attempt to

Tycho. Moon's Age, 9·24 days.

delineate the extremely disturbed and rugged region surrounding Tycho, confining ourselves strictly to drawing the crater itself. The central hill shown above is between 5,000 and 6,000 feet high, its conical shadow being very conspicuous at the time our drawing was made. The inextricable mass of craters, hillocks, pits, and irregularities in the immediate neighbourhood of Tycho almost defies any attempt to draw or map it. The wonderful system of light rays radiating from this great crater extends over at least a quarter of the entire visible hemisphere of the moon. Some of them may be traced to the southern limb, and doubtless extend beyond it into that hemisphere which is always hidden from the terrestrial observer. One tremendous ray passes through the Sea of Serenity, the craters 70 and 73 in our Map (Vol. III., p. 223), lying upon it. Another very conspicuous one connects Tycho with the interesting formation Bullialdus (213). It is a notable fact that while these rays in nearly every other instance pursue their course through hill, valley, crater, and plain without deviation or interruption, the crater Saussure (196) has deflected one of them, and caused it apparently to bend round its southern wall. *What* these stupendous bands are can only be regarded, at present, as a mystery. Nasmyth considers them to be cracks filled up with molten lava from the Moon's interior; but arguing from their terrestrial analogues, trap-dykes, we should expect to find them projecting more or less above parts of the lunar surface, and, as a necessary consequence, casting shadows when on or near the terminator. As a matter of fact, we find them, everywhere, absolutely level with the regions which they traverse. Of whatever material they are composed, its reflective power must be very high, inasmuch as the ray-system of Tycho traverses the (in many cases) huge and complicated formations, Sasserides (183), Gauricus (185), Heinsius (190), Wilhelm I. (191), Longomontanus (192), Clavius (193), Maginus (195), Orontius (197), Nasir-ed-din (198), Lexell (199), Walter (200), Moretus (262), Stöfler (354), and Maurolycus (358), all which are most conspicuous objects when obliquely lighted; but which, one and all, disappear wholly at full moon, or under vertical illumination! The late Professor Nichol, amid much which, after all, merely amounted to assertion, did point out one valuable piece of evidence furnished by these rays; and that is, the proof afforded by their continuous visibility and the homogeneous character of their brightness throughout their course, that the reflective substance of which they are composed is absolutely everywhere uncovered. Did anything in the shape of vegetation, for example, exist in the moon, it must obscure portions of these light streaks. That they pass undimmed, then, from their origin to their termination, shows plainly enough that they traverse "a rocky desert, devoid of life or living thing." Here our night's work may cease. We shall turn our telescope upon Copernicus (112) as soon as it is favourably illuminated.

One Month before Summer Solstice. Summer Solstice. One Month after Summer Solstice.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

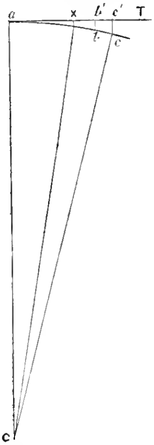
I GIVE this week our Sun Views of the Earth for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight of Greenwich solar time, one month after the summer solstice. For comparison, I repeat the Sun Views for June and May.

FLIGHT OF A MISSILE.

By Richard A. Proctor.

Prop.—*To determine what westerly deviation is produced in the case of a missile fired vertically from the equator to a height* h (*the resistance of the atmosphere being neglected*).

The real cause of the westerly deflection is the action of gravity during the time of flight retarding the motion originally possessed by the missile at right angles to the line joining the earth's centre and the point whence the missile was projected.



Let $a\,b\,c$ be part of the equator, a the point whence the missile is projected vertically, with velocity $\sqrt{2\,gh}$, so that it reaches the height h in time t_1, and in time $2\,t_1$ reaches the ground again at b, the point a having in the mean time been carried to c, so that $b\,c$ is the westerly deviation we require to determine.

Let c' be the point in a T which a body moving in the straight line a T with constant velocity v would reach in time $2\,t_1$, b' the point which it would have reached if constrained to move in the straight line a T, but with its velocity in this direction, v at starting, affected by the action of gravity, so that $b'\,c'$ is the deviation we require; for the arc $a\,c$ is so small that for the purpose of this inquiry, the inclination of $b\,c$ to a T may be neglected. We also may manifestly neglect the variation in the force of gravity due to the varying distance of the actual missile from the earth's surface.

Suppose that in time t the body has reached the point X, put $a\,\mathrm{X} = x$, and join C$\,x$ (C being the earth's centre). Then the retarding action of gravity on the body at X is equal to $g\frac{x}{r}$ (r being the earth's radius). Hence we have—

$$\frac{d^2x}{dt^2} = -\frac{gx}{r}$$

$$\frac{2d^2x}{dt^2}\cdot\frac{dx}{dt} = -\frac{2gx}{r}$$

and $\left(\frac{dx}{dt}\right)^2 = -\frac{gx^2}{r} + \mathrm{C}$. But when $x=0$, $\left(\frac{dx}{dt}\right) = v^2$

$$\therefore \left(\frac{dx}{dt}\right)^2 = -\frac{gx^2}{r} + v^2$$

$$\left(\frac{dt}{dx}\right)^2 = \frac{r}{rv^2 - gx^2}$$

and $$\frac{dt}{dx} = \sqrt{\frac{r}{g}}\,\frac{1}{\sqrt{\frac{rv^2}{g} - x^2}}$$

wherefore $$t = \sqrt{\frac{r}{g}}\sin^{-1}\left(\frac{x}{v}\sqrt{\frac{g}{r}}\right)$$

or $$x = v\sqrt{\frac{r}{g}}\sin\sqrt{\frac{g}{r}}\,t \qquad (\text{Constant} = 0)$$

Hence, since in time $2t_1$, the body is at b', we have

$$ab' = v\sqrt{\frac{r}{g}}\sin\sqrt{\frac{g}{r}}\,2t_1$$

$$= v\sqrt{\frac{r}{g}}\left[\sqrt{\frac{g}{r}}\cdot 2t_1 - \sqrt{\left(\frac{g}{r}\right)^3}\cdot\frac{8t_1^3}{2\,.\,3}\right]$$

[approximately

$$= 2vt_1 - \frac{8v}{2\,.\,3}\cdot\frac{g}{r}t_1^3$$

But $ac' = 2vt_1$

$$\therefore b'c' = \frac{4}{3}\,\frac{vgt_1^3}{r}$$

Now $h = \frac{gt_1^2}{2}$; and $v = \frac{2\pi r}{\mathrm{P}}$

$$\therefore b'c' = \frac{8h}{3}\cdot\frac{2\pi t_1}{\mathrm{P}} = \frac{16\pi h t_1}{3\mathrm{P}}$$

the same result which was obtained by the simpler method of regarding the missile after it had once left the earth as travelling in an elliptical orbit around the earth's centre, and subject, therefore, to the second law of Kepler.

If the missile is projected in latitude λ, it may easily be shown that the westerly deviation

$$= \frac{16\pi h t_1 \cos\lambda}{3\mathrm{P}}$$

The mean daily motion of the air in 1882 was 306 miles, being 27 miles greater than the average. For the month of November, the mean daily motion was 449 miles, being 150 miles above the average. The greatest daily motion was 758 miles on Nov. 4, and the least 30 miles on Dec. 11. The greatest hourly velocity was 64 miles, and the greatest pressure—with the chain—29 lb., on Oct. 24.

Remarkable Phenomenon in Glenisla, Forfarshire.—About two o'clock on the afternoon of Wednesday, the 11th current, the sky was very dark, and I was on the outlook for thunder, when, standing at Broomhall, in Glenisla, my attention was attracted by a peculiar noise, similar to that produced by a train crossing a bridge. This noise was very loud, and seemed at first to be distant, but latterly it came quite near, and sounded like the rapid discharge of musketry, with a booming sound. There was no rain at this time, but a few minutes before there had been a heavy fall of rain, accompanied with a thunder-peal. I looked up, and saw about a mile away a large cloud twisted in the form of a screw, and revolving round and round at a very rapid rate. It looked like a huge column of steam, and cloud, and vapour, about fifteen yards in breadth, and so high that the top of it went out of sight. It was narrow towards the earth, and spread out in its screw form as it reached its extreme height, with huge volumes of what looked like steam or smoke in its train. The effect was grand. It rose above the horizon, which from my point of view was formed by a wooded hill on the south, and gradually descended towards the earth. It had two motions, one circular and the other forward, and the latter I guessed to be at the rate of a mile in $2\frac{1}{2}$ minutes. It seemed to be engulfing everything in its vortex, and was scattering branches, and what appeared to me pieces of burnt paper, but which turned out to be slates. The air was pervaded with a strong sulphurous smell. I followed the vision, which was that of a "rushing mighty wind," over the other line of the horizon to the north towards a mill-pond, from which it sucked up water in great quantities, which appeared to be absorbed and scattered in its weird-like dance. On further inquiry I found that this same visitant had in this immediate neighbourhood knocked down stone dykes, levelled trees, tirred a cottage, which it shook, shattered its chimney-cans in a thousand pieces, and scattered the zinc ridges for hundreds of yards. The fields in its train are strewed with limbs of trees, slates, and splintered wood, and the whole advent was so solemn as to strike with terror men, women, children, and the beasts which were in the field; and doubtless others of your correspondents will recount its story and tell its name.—*Dundee Advertiser.*

Editorial Gossip.

My lecture audiences in the Philharmonic Hall, Southampton, very considerably exceeded the "small dozen" which an astronomical resident assigned as the total number here who take the least interest in astronomy. In fact, they were excellent audiences, both in size and quality. It was particularly pleasing to me to find that the numbers present increased as the course proceeded. I regretted the more that the third lecture was given under considerable difficulties, and, indeed, ought not to have been given at all. I was a passenger by the 7.50 train from Portsmouth on Saturday morning, which ran into a heavily-laden excursion train, and have felt since (like Pete Jones after his encounter with Bud Means) "consid'able shuk up." It was a somewhat singular experience to me to lecture under such conditions, and I was interested to find that for the greater part of the time the mere mechanical action of speaking went on, or seemed to go on, almost without thought. But the effort was trying, and I shall be careful how I repeat it before I have recovered my customary working powers.

Good service may be done occasionally by showing the class of readers who place reliance on anonymous criticisms, the shallowness of average criticism, and the dishonesty of a good deal which is below the average in one sense, but in cleverness often rather above it. A criticism of my Mysteries of Time and Space, by no means unkindly in tone, though amusingly corrective considering the writer's manifest inexperience, has been sent me by a good-natured friend (never mind the theological participle), for notice, I suppose. It appears in the usually rather caustic pages of the *Saturday Review*, but I must admit that the purpose of the writer seems throughout to impart information, not to cauterise the poor author. This is kindly meant, and as I should imagine from his remarks that my friendly critic really has given an hour or two for every year that I have given to the subjects about which he wishes to set me right, he stands manifestly on higher ground than the average critic. That he has not read my book is clear enough, from his remark that the essay on "Herbert Spencer's Philosophy"—which introduces most stupendous "mysteries of time and space"—has no business in the book at all, and from his reference to Mr. Spencer's special law of the "Persistence of Force," which might be erroneous, yet his philosophy sound. But it is an exceptionally honest critic who reads everything on which he comments, and my critic really is very fairly honest. Nine-tenths of his corrections present only misapprehensions of his own.

What I wish specially to note in this criticism is the following remark on my essay, "A Survey of the Northern Heavens":—"Mr. Proctor, who has investigated the matter very carefully, maintains that at the end of his life Herschel gave up all belief in either of his two methods of 'star-gauging;' but we could wish that he had noticed the arguments on the opposite side which have been lately put forward by Professor Holden in his short 'Life and Works of Sir William Herschel.'"

I believe that I have given to the study of Sir W. Herschel's papers more time and attention than anyone else has yet bestowed on them, not excepting William Struve, who however is a long way ahead of all others in this respect. His conclusions and inferences are almost exactly the same as mine, neither of us, by the way, having ever suggested any such absurdity as that which the critic attributes to me. Herschel never "gave up all belief in either of his two methods of star gauging," but he did give up the theories he had based on them. But if I had not been content with my own and W. Struve's study of Herschel's papers, it is at least not likely that I should notice arguments respecting them put forward by Professor Edward Holden, formerly of Washington and now of Ann Arbor, Mich., celebrated for years past as the man who has most notably surpassed the usual achievements of book-reviewers. They have sat in judgment sometimes on books they have not read, and it is whispered that one or two of them have sat in judgment on books they have not even seen. But Prof. Holden, aiming only at the latter achievement, unfortunately shot so far beyond his mark as (unwittingly) to pronounce judgment on a book which—though announced for early publication two years before—had not been completed, and has not been published yet! *His* remarks on the long and difficult series of papers written by Sir W. Herschel must be worth noticing indeed!

There is a good illustration in a recent number of *Nature* of the risk arising from the constant custom of putting a comma before "which." In an article on cholera, a writer is made to say "that the disease has, in this country, been mainly associated with the use of water supplies, which have been subjected to the risk of receiving special infection." I daresay the compositor supposed that in throwing in the comma he was correcting slipshod punctuation. As a matter of fact he made the author he was correcting teach that we should refrain from the use of water supplies (which would be awkward), and for the reason (which would be rather scaring, if true) that our water-supplies have one and all been subjected to the risk of receiving special infection.

I am glad to see that our musical critics, who usually waste a good deal of their ink in writing fanciful nonsense, have begun to notice the evil habit which some of our operatic singers have of showing off their voices at the expense of their parts. Albani is a great offender in this respect. With a magnificent voice (the musical critics will smile at such a word as "voice" being used, instead of the impressive "organ"), Albani sometimes gives pain to hearers who really love music by introducing into some expressive phrasing a marvellous bit of trilling, as utterly out of place as a somersault would be towards the close of Hamlet's suicide soliloquy. If Nilsson or Patti, who, we know, *can* achieve all that Albani does, were to lose no opportunity of doing so, they would not hold the place they do in the hearts of all who prefer singing to musical gymnastics.

By-the-way, might not something be done to teach audiences how and when to applaud. Perhaps some of our singers, especially at concerts, are more to be blamed than the audience, for often by their action they suggest that the right time to applaud is when their own voices cease to be heard. Be this as it may, much sweet music is lost through the stupid habit of those listeners who think only of the voice, and drown what Beethoven, Mozart, or Rossini (who perhaps knew rather better than these noisy ones) thought an essential part of the performance. One often feels that concerts and operas could only be properly enjoyed if none were admitted to hear them who did not know something and care something about music. As it is, more than half our audiences seem to be of the opinion of Lord Foppington, that listening to the music, though "pardonable in the country," is "a monstrous inattention in a polite assembly." But this is a very old trouble.

CHOLERA.

(*Preventive.*)

To the Editor of KNOWLEDGE.

THE progress which medical art combined with sanitary arrangements have made since 1866, has greatly diminished the dread of this epidemic. Yet forewarned, forearmed; for not to be watchful against danger is foolhardy. The most important thing is not to be afraid of it, since terror, fussing, and worry destroy more than disease. Pay very strict attention to body and home cleanliness, diet, and daily exercise, with avoidance of heavy drinks, greasy substances, and fruits.

In my large London parish the following proved most successful:—Experience has taught me that more depends upon pure water, boiled (best) or filtered, than anything else. A simple filter (costing a few pence) is made out of a common 6-in. garden pot plugged with sponge; at the bottom a layer of 1½ in. of powdered wood or bone-charcoal, then 2 in. of silver sand, and on top 1½ in. clean washed small pebbles. Renovate every eight or ten weeks. Or Atkins' (62, Fleet-street, London) splendid carbon filters, 2s. 6d. to £2. 2s.; or Lipscombe's, 233, Strand. If diarrhœa or pains come on, the following reliable Indian remedy, which has been very successful during previous visitations in London, and which your chemist can make for 6d. to 7d.—and taken within a quarter of an hour—will prove very beneficial:—

Sp. pro Mist. Cretæ	℥ss.
Conf. Aromat.	ʒiss.
Tinct. Catechu.	ʒiss.
Tinct. Opii	m.xx.
Ol. Cinnam.	m.vj.
Aquæ ... Ad.	℥vj.

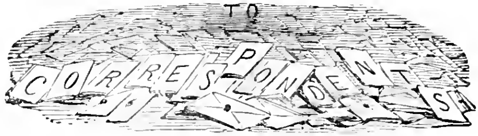
Fiat Mist.

Adults	3 table-spoonfuls	every	3 or 4	hours.
Ages 7 to 16	1½	,,	,,	,,
,, 4 to 7	3 teaspoonfuls	,,	,,	,,
,, 3 to 4	2	,,	,,	,,
,, 1 to 2	1	,,	,,	,,
,, Under 1	½	,,	,,	,,

(Beef tea, mutton broth, arrowroot, boiled rice.)

Always keep some of the mixture in store, also a bottle of Dr. Collis Browne's Chlorodyne. If any complications arise, without a moment's delay call in your doctor. I hope what formerly proved so efficacious may be again beneficial to my fellow-creatures.—A. STYLEMAN HERRING, Vicar of St. Paul's, Clerkenwell, London.

THE EDISON ELECTRIC LIGHT.—The Criterion Theatre, Piccadilly, is to be lighted throughout with about six hundred Edison incandescent lamps. The generating plant will comprise two Armington & Sim's horizontal high-speed engines, having 13″ cylinder by 13″ stroke, running at 275 revolutions per minute, and driving on to counter-shafting, from which will be run four Edison *L* dynamos, each capable of sustaining 150 16-candle lamps. Each engine will be capable of indicating 84 h.p., at 70 lbs. pressure, and either engine will thus be able to take the whole load in the event of accident or repairs to the other. The wiring will be arranged on eight circuits, each under independent control by means of a specially designed regulator, capable of lowering or raising the brilliancy of the lamps from normal candle power to *nil*. The contract for the work, which will be carried out by the Edison Electric Light Company, stipulates for the completion of the installation by the beginning of September.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

LARGE SUN-SPOT.

[880]—It may interest "Excelsior" (letter 866, p. 29) to learn that I measured the fine spot—or rather group of spots—to which he refers, on June 30, and that the total superficial area of the sun involved in that stupendous disturbance amounted to 1,837,310,200 square miles! The superficial area of our own world, it may not be unworthy to note, is only 197,000,000 square miles.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

GEOMETRICAL AND REAL PERSPECTIVE.

[881]—It is the practice of artists to exaggerate the size of distant objects. Imagine, for example, in a landscape, a distant hill with a lake in front of it, and a man walking across the foreground so that the observer sees the collar of his coat in a line with the top of the hill, and the end of his coat-tails with its base; the artist will probably show the top of the hill above the man's hat, and the base correspondingly low. When the sketch is compared with a photograph, it looks correct, but the photograph makes the hill look too small. The following is suggested as a likely explanation:—

The camera takes its picture in true geometrical perspective, except as regards slight errors due to the lenses, and differences of focus. By using a camera with a small hole, instead of lenses, these may be avoided. In the camera the man's coat takes the same height on the screen as the hill does, but still, in the photograph, the hill looks too small. On looking at a picture or photograph, the eye has not to alter its focus, and can see two objects supposed to be at different distances simultaneously, and sharply defined. Thus, on looking at the photograph, the coat covers the same height on the retina as the hill does; but in the case of the picture the hill corresponds, perhaps, to the man's coat, hat, and other kind of garment, which, by-the-bye, the artist will have shown bright red for the sake of the blue and yellow of the picture. In looking at the real scene, the eye has to adapt itself to the different distances, as it cannot look at near and remote objects at the same time. On looking from the man's coat to the hill, it alters its focus; and this it does, not like a lens camera, but by increasing the focal length of its lenses by flattening the crystalline lens. A result of this is, that the image of the hill on the retina is enlarged, and occupies more height than the man's coat did when in focus, justifying the artist's practice.

The effect of this action of the eye is easily seen by holding a pencil, or anything suitable, between the eye and a distant object, and looking from it to the pencil and back quickly. The object appears to change its size. By holding the pencil so as to subtend the same angle as some dimension of a distant object of striking colour, and then, having previously looked at the object till the eye is somewhat fatigued, looking at the pencil, the images on the retina may be compared, as the object will still be visible in complimental colours. JAS. SWINBURNE.

SINGULAR PHENOMENON.

[882]—A short time ago, I was pricking out some annuals on a flower-bed, on which some geraniums were already planted, when I was surprised to see flashes of light coming from a truss of geranium flowers. At first I thought it was imagination, but my wife

and a friend who were present also saw them. Time was about 9 p.m., and the atmosphere clear. There were other geraniums of a different colour on the same bed, but there was no effect on them. The particular geranium was a Tom Thumb.

Is this at all common? I have never seen or read of it before.

S. INGHAM.

SKYERS.

[883]—With reference to your note upon the absurd statement of the "Spectator" that a "skyer" can only result from a drive, will you allow me to point out that nothing is more common than for a batsman to hit *under* the ball in hitting to leg, with the almost invariable result of sending it spinning over his shoulder towards "long slip," or, perhaps, "third man;" and such a hit is a veritable "skyer," both in a literal and what one may call a technical sense.

A "skyer" from a *late* hit to leg would be indeed a curiosity. I should be sorry to be keeping wicket when it happened.

F. M. D. UPLOCK.

[Yes; I knew a bowler who had a favourite dodge based on the fact mentioned by Mr. Uplock. When bowling to a batsman who favoured leg-hitting, he would send an occasional leg-ball with a break from the off-side, or *away* from the wicket. Such a ball, pitched rather forward, is very apt to be hit under, with the result of sending a "skyer" to long slip. Especially is this the case if it comes after several leg-balls sent down with the right sort of break for taking the wicket—that is, a break from leg.—R. P.]

DRESS REFORM—MEN.

[884]—I am in my "forties," and since my youth have discarded braces, belt, or buckle. I merely have my trousers made to a "nicety," to fit just over the hip. Anything more comfortable is beyond my imagination. I think my tailor has not taken my measure more than two or three times during my "career," so that this ordeal has been avoided.

A. G.

[Unfortunately some men, oppressed with over-much adipose tissue, have no hips worth mentioning.—R. P.]

RATIONAL DRESS: THE KILT.

[885]—In all the letters and papers which appeared in KNOWLEDGE on dress, I am surprised that our national dress, the *kilt*, has not been referred to. Those of us who are in the habit of, at times, wearing it, and at other times trousers, know how much more comfortable and pleasant it is than the latter. Two things, however, are indispensable to this comfortableness and pleasantness. (1) That it be made so as to balance perfectly and hang all round with an equal weight, and (2) that it be fixed with large pins, and with no such things as straps and buckles attached to it. The difficulty is to find a tailor who knows how to make a kilt which will balance. For ten years of my life, having worn nothing else, I can speak with full knowledge. Perhaps my friend Dr. Gillins, who has been associated with me in other Celtic matters, can throw some light on its healthfulness.

CHARLES STEWART.

EARTH-SHINE.

[886]—While looking at the moon recently with a $3\frac{3}{8}$ equatorial, the "Earth-shine" was most distinctly visible. A friend, to whom I pointed it out, saw it also most plainly. I was not aware before that this was visible when the moon is *eight days old*.

W. H. K. SOAMES.

[It is very seldom so seen in England. In America and Australasia I have seen it—even later.]

FIGURE-CONJURING.

[887]—It may surprise "G. M." to know that the figure-conjuring he read of in a French book was practised upon verdant students of mental arithmetic in my early days at an ordinary English elementary school, only the ending was varied. Instead of asking the youthful arithmetician to hand him a slip of paper showing the final product, the "conjuror" would say: "Now, deduct the number you first thought of," and afterwards proclaim the result, *without seeing any paper, or being told anything*. Between boys who were in the secret the whole method was worked mentally, by way of exercise, but four figures were "one too many" for us.

A. B. C.

A VERY COMPLETE MAGIC SQUARE.

[888]—In looking over the early numbers of KNOWLEDGE, my attention was drawn to an arranged square of nine, on page 273, Vol. I., copied from a tablet inserted in the wall of a villa near Rome, when it struck me that I could improve upon that arrangement, and accordingly I have succeeded in constructing a square of nine, beyond which I think it would be difficult to go. In the accompanying figure the number 369 is produced by each vertical, horizontal, and diagonal row of cells; by the angles, whether right, acute, or obtuse; from the corners, or the middle from the centre, which will still hold true should both side rows, or top and bottom rows, or all four be taken away. The next rows, in a similar manner, may be removed with like results. The figure is divided into nine smaller squares, each of which contains the number 369. Should we take the diagonals of any three of the smaller squares lying in a line of which the central square is one, the same number is obtained. In fact, any three cells with their corresponding opposites with any three of the central squares which form a line passing through cell 41, or any four taken in a like manner along with that cell alone, will produce the same result, nine cells always being necessary for the purpose, of which the central must in most cases be one. A very little investigation will show the principle upon which the figures has been constructed. In how many ways can the number 369 be produced?

G. S.

35	16	28	10	63	76	70	50	21
56	45	79	30	5	38	31	71	14
36	65	9	58	67	22	49	1	62
64	42	8	75	29	23	2	48	78
25	43	69	27	41	55	13	39	57
4	34	80	59	53	7	74	40	18
20	81	33	60	15	24	73	17	46
68	11	51	44	77	52	3	37	26
61	32	12	6	19	72	54	66	47

MECHANICAL PUZZLE.

[889]—Here is a mechanical question which puzzles, and which I should like inserted in KNOWLEDGE, with a view to its solution:— If a body moves with a certain velocity, it has a certain amount of kinetic energy; if at twice that velocity, its energy is four times the first amount, for the energy in a moving body is as the square of its velocity. Now, when a person moves a body (say throws a stone) the work he does or energy he expends is in proportion to the V^2 of the body moved (assuming the mass to be constant). Suppose A to throw a body with a velocity V, and suppose B to be riding alongside of that body and at the same rate (V) to B, the body will be relatively at rest. Let B now lay hold of the body and give it a new velocity V, the body will now move with a velocity 2 V, and have, therefore, *four* times the energy that it had at first; but A and B have done equal work on the stone, each imparting a velocity V, and therefore an energy equal to one-fourth of what the stone now has—together equal to one-half? Where does the other half of the energy come from?

FORCE.

[From the horse, or other animal on which our friend B may be riding.—R. P.]

PROBLEM IN PROBABILITIES.

[890]—I send you a question in probabilities which appears to me to be rather peculiar, and shall be glad of your opinion on it, or that of your correspondents.

Required the separate chances (1) of dividing; (2) of taking the whole of a six pool. N.B.—Players of equal skill.

Since one out of the six players must either take the whole or divide, and each has the same chance of doing so,—

chance of either dividing or taking the whole for each player $= \frac{1}{6}$

Again, each player may divide in five ways, but can only take the whole pool in one way. [But are the six chances here considered equal?—R. P.]

Assuming, therefore, that the chance of dividing : the chance of taking the whole :: 5 : 1 we get—

$$\text{Chance of dividing} \ldots\ldots\ldots\ldots = \frac{5}{36}$$

$$\text{,, \quad ,, taking the whole} = \frac{1}{36}$$

But is this reasoning correct?

HAZARD.

LETTERS RECEIVED, AND SHORT ANSWERS.

JOS. CLAYTON. Yes; the planetary aspects were evil, in the astrological sense, when those particular catastrophes happened. But it would be hard for all the catastrophes to happen when the planets were more smilingly arranged. If you know anything of astrology, you know that about one-third of the time the aspects are evil; for another third they are good; for the rest of the time they are both good and evil. Consequently, for two-thirds of the time you can indicate evil planetary aspects. Thus, in the long run, two-thirds of all the catastrophes will occur when the planets, according to astrologers, threaten evil. Leave the other catastrophes out of consideration, and—there you are: astrology is shown to be a true science. Only as a mere detail, so to speak, it may be noticed that if the good aspects were regarded as the evil and *vice versâ*, astrology would be just as satisfactorily established.—SENEX. (1) Unfortunately, pictures of spots could only appear after the spots had gone out of view. Then what use would they be? They would be meant, I suppose, for telescopists, and the telescopist can see them for himself. (2) It often happens that the penumbra of a spot looks widest towards the nearer edge of the sun. The circumstance is considered and illustrated in my book on the sun. It does not militate against the theory of spots being cavities, but shows that the evidence which has proved them to be cavities is not always presented.—J. B. *Ask* your plain question; you omit this trifling detail in your last letter. Dictionary meanings of such words as "level," "horizontal," &c., are, nine times out of ten, wrong.—W. LALANDE. Nothing personally.—S. INGHAM, F. Ω L. See Mr. Theobald's advertisements.—AN INQUIRER wishes to learn the name and author of any exhaustive work on the history, manners, character, &c., of the Chinese. — TRESILLIAN, MORE LIGHT. It would afford a very inconvenient precedent to do what you wish, or I would, gladly. — AN INTERESTED READER OF "KNOWLEDGE" would like to see a protest here against the wholesale destruction of butterflies for stocking collections; also to learn if the leaves of the garden rhubarb are poisonous, and if water in which potatoes have been boiled is unwholesome. An "I. R. of K." mentions also an amusing instance of ignorance in a charwoman, who, having accidentally run the nib of a rusty pen into her thumb, covered the *nib* with grease and put it carefully away on a shelf, to prevent her *thumb* from festering.—A LOVER OF THE STARS. If you were on a world travelling round Alpha Centauri, and could see both the Sun and Neptune, you would find the distance between them equal to about 32 seconds of arc, or, in other words, they would appear as a rather wide double star, not like Gamma Virginis.—JAS. SWINBURNE. Thanks.—HUGH DALZIEL. Rather more suitable to *The Field* than to these columns.—Rev. W. HARTMAN, LL.D. Considering the nature of the subject, may we not admit on both sides that *some* problems in psychology, which in former times were explained as due to spiritual agencies external to our personality, may be rationally explained *now* as due to processes simply natural? If the "some" of several be "all," while the "some" of other some are few, the contest over the difference should be waged elsewhere. Mr. Clodd, you may be sure, meant no scorn for accepted beliefs about external agencies; nor does he definitely reject them for all cases. But you must admit that many cases of supposed demoniac influence have had an internal, not an external origin.—LEONARD RODWAY. The indestructibility of energy is really against your views. If the earth is constantly radiating heat into space, she cannot retain it unchanged in amount within her own globe. So long as the crust is drawing on the internal supplies, it is natural that there should be little *apparent* change of temperature.—W. G. MORTIMER. Do not know the address of the Ladies' Dress Reform Association.—J. HOMER. Such an article might be of interest. Must see it before I can say.—C. G. MEETKERKE. Thanks, but paper not suitable; shall it be returned?—J. LAWSON. In early numbers of KNOWLEDGE a great number of magic squares were given. See Mr. Sutton's square of 9, shortly.—J. M. GLADSTONE.—The figure simply gives the lengths corresponding to vibrations for various notes.—M. GRIFFITHS. The question is scarcely an optical one. People do not really estimate the size of the sun when they say it looks as large as a cheese-plate, a sixpence, a round table, or so forth. Its apparent size is the same for all, and not a matter for estimation, except for those who wish to learn precisely how many seconds of arc the disc's diameter really subtends. When anyone says the sun looks as large as, say, a halfpenny, he really asserts that it seems to him about nine feet away, for at that distance a one inch globe (a halfpenny is exactly one inch in diameter) would look as large as the sun.—W. T. SOUTHWARD. I can only say that I differ from you. If science said dogmatically there is no such thing as a disembodied spirit, there is no future life, and so forth, your objections would be sound enough. But that science should not be permitted to discuss the ascertained origin of many of the beliefs men have formed and formulated respecting matters spiritual, seems to me altogether absurd. If you are right, I am not a recent offender, or officially so only (as editor, to wit) against your doctrine. In the Essay on Ghosts and Goblins, in my "Borderland of Science," I consider certain cases of supposed apparitions, and show how they were to be explained. This, of course, is not the same as asserting that ghosts and goblins never can appear or have appeared; yet you would say that I had no business even go so far, and that you consider science is "degraded by attempts to explain," &c. It is absolutely certain that many races have based doctrines about disembodied spirits, a future life, heaven, hell, &c., on mistaken notions about shadows, dreams, optical phenomena, the sky, subterranean fires, and so forth. To show this is not to assert that there is no future life, no disembodied spirit, no spiritual Heaven or spiritual Hades; and undoubtedly science has the fullest possible right to consider the origin, progress, and decay of mistaken interpretations of shadows, dreams, the arched sky with its celestial phenomena, sulphurous volcanic regions, *und so weiter*. Whether ideas about disembodied spirits, heaven, hell, &c., are in themselves right or wrong, makes no difference in this respect. If they are wrong, there is nothing to be said for them; if they are right, they cannot be too soon dissociated from erroneous explanations.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART IX.

WE may remark in passing that there is no absolute necessity for restricting ourselves in all respects to Euclid's manner. Take as an instance his treatment of the famous *pons asinorum*. In dealing with this, as with all other propositions, he confines himself entirely to constructions which he has shown to be possible. Therefore, the following proof of the first part of the proposition would not be *in his manner*, though it would be difficult to find any flaw in the reasoning.

There must be *some* line which divides B A C (Fig. 17) into two equal angles.* Let A E represent this line. Then in the triangles B A E, C A E, B A is equal to A C (*hyp.*); A E is common; and the angle B A E is equal to the angle C A E. Therefore (by I., 4) the angle A B E is equal to the angle A C E.

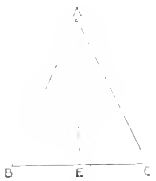


Fig. 17.

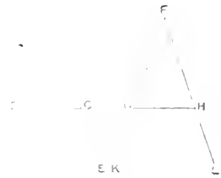


Fig. 18.

Again, the following proof of both parts of the proposition is complete, though not in Euclid's manner:—

Conceive that the figure formed by the lines F K, F L, and G H, Fig. 18, is one that would coincide exactly with the figure formed by the lines A D, A E, and B C; F K coinciding with A D (Fig. 18), F L with A E, and G H with B C. Now conceive the figure F K L to be turned face downwards, and so applied to the figure A D E that F K may coincide with A E; then since the angle G F H is equal to the angle C A B, F L coincides with A D. Also since A B, A C are equal to each other, and also to F G, F H, the points G and H coincide with the points C and B, and G H with C B. Thus the angle A B C coincides with and is equal to the angle F H G. But by our supposition the angle A C B is equal to the angle F H G. Therefore the angle A B C is equal to the angle A C B. In like manner D B C coincides with G H L;† but, by our supposition, B C E is equal to G H L. Therefore D B C is equal to B C E.

* The assumption here is precisely the same in character as that made in defining a right angle.

† Here we assume as axiomatic the property which Simpson has attempted to prove in the corollary he has added to I., 12. He forgot, apparently, that Euclid had already (in prop. 4 and elsewhere) assumed the property as self-evident, and that prop. 12 itself cannot be solved on any other assumption.

Or, we may produce A B and A C in Fig. 17, and conceive the part of the figure to the right of A E rotated round A E till it falls on the part to the left, and then show the perfect coincidence of the two portions.

In attacking geometrical deductions we are often compelled to assume in this way the existence of figures which are clearly *conceivable*, though we may not know precisely how to construct them, or though it may even be impossible to construct them by any of the ordinary geometrical processes. The following example of a problem in geometrical maxima and minima affords an instance.

EX. 11.—*A C B, Fig. 19, is part of a circle whose centre is at O. The points P and Q lie without the circle. Determine under what conditions the sum of the distances P C and Q C will be a minimum.*

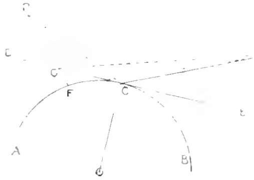


Fig. 19.

Here guided by Examples 8, 9, to which the above is supposed to be given as a rider, we are readily led to the inference that P C and Q C should be equally inclined to the tangent at C. Now there is no simple method of determining C so that this relation may hold. But it is clear that there must be *some* position of C for which it holds. Conceive, then, that P C and Q C are equally inclined to D C E, and let us inquire whether their sum is a minimum. Take any point F in A C, and join P F and Q F. Then we have to show that P F and Q F are together greater than P C, C Q. Let P F meet D C in G and join G Q. Then P G and G Q are together greater than P C and C Q (Example 9); and P F, F Q are clearly greater than P G, G Q (Euclid I. 20). Hence, *à fortiori*, P F, F Q are together greater than P C, C Q. Therefore the sum of P C and C Q is a minimum.

COR.—Join C O, then the angle P C O is equal to the angle Q C O, and we may express the relation deduced above thus:—

The sum of the lines drawn from any point without a circle to a point on the circumference will be a minimum when the two lines are equally inclined to the radius drawn to the last-named point.

The subject of geometrical maxima and minima is a wide one, but we shall content ourselves here by adding three in which areas are dealt with.

EX. 12.—*Two sides of a triangle being given it is required to construct the triangle so that its area shall be a maximum.*

Let A B, B C, Fig. 20, be the lengths of the given sides.

With centre B and radius B C describe the circle C D F E. Then if we draw any radius B D or B E, and join A D or A E, it is clear that the triangle A B D or A B E thus constructed will have sides A B, B D, or A B, B E of the required length, and it is obvious that the area of any triangle thus formed will be greater or less, according as the distance of its vertex from the line A B C is greater or less. We have not, indeed, any problem in Euclid which

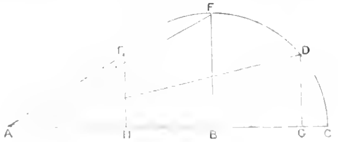


Fig. 20.

expressly states this as a truth respecting triangles on the same base, but the property is clearly involved in the proof of I. 39. Now since the vertex must lie on the circle C D F E, it is obvious that the distance of the vertex from A B C can never exceed the radius of this circle, and can only be equal to the radius when the side adjacent to A B is at right angles to A B. Draw B F at right angles to A B, and join A F. Then the triangle A B F is the triangle of maximum area under the given conditions. The proof consists in showing that D G or E H drawn perpendicular to A B C is less than B F. This is evident; for in the right-angled triangle B D G, the angle D B G is less than a right angle, therefore D G is less than B D; that is, than B F.

Our Chess Column.

BY MEPHISTO.

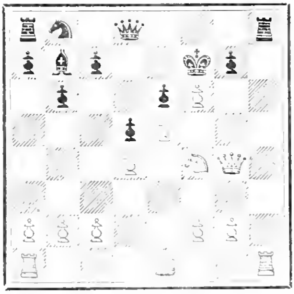
SCORE ON SATURDAY THE 21ST INST. OF THE INTERNATIONAL TOURNAMENT AT NUREMBERG.

Names.	Bardeleben	Berger	Bier	Bird	Blackburne	Fritz	Gunsberg	Hruby	Lange	Leffmann	Mason	L. Paulsen	W. Paulsen	Riemann	Schallopp	Schottlander	J. Schwarz	Weiss	Winawer	Total score
Bardeleben...	—				½		1		1	1		½	1		0	½			0	5½
Berger		—	1	½	½			½		1		½	½	½		½				5½
Bier..........		0	—	0	0			½				0		0	½		1			2
Bird		½	1	—		½	½		1			1				0	½		0	5
Blackburne..	½	½	1		—					½		½		1	0		1			5
Fritz				½		—			0	½	1	½	1				0		0	3½
Gunsberg ...	0			½			—		0	1	0		1		0		½		1	4
Hruby........		½	½					—		1		½			0	½	½	½		4
Lange........	0			0		1	1		—	1	0			½			0			3½
Leffmann ..	0	0			½	½	0	0	0	—			0					½		1½
Mason						0	1		1		—			½	½	1			0	4
L. Paulsen ...	½	½	1	0	½	½		½				—				½				4
W. Paulsen ..	0	½				0	0			1			—	0	1			½		3
Riemann......		½	1			0			½		½		1	—		½	0	½		1½
Schallopp ..	1		½		1		1	1			½		0		—			1		6
Schottlander	½	½		1				½			0	½		½		—		0	0	3½
J. Schwarz...			0	½	0	1	½	½	1					1			—	½		5
Weiss								½		½			½	½	0	1	½	—	1	3½
Winawer ...	1			1		1	0				1					1		0	—	5

GAME PLAYED IN THE NUREMBERG INTERNATIONAL CHESS TOURNAMENT, JULY 16, 1883.

POSITION after White's 16th move of Q to Kt4:—

MASON.
BLACK.



WHITE.
FRITZ.

French Defence.

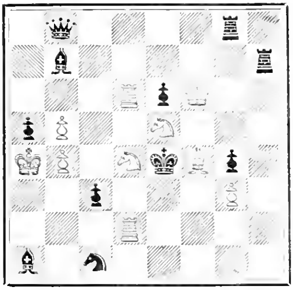
WHITE.	BLACK.
16. Q to Kt4	R takes R (ch)
17. K to Q2	P takes P
18. Q to Kt6 (ch)	K to K2
19. Q to Kt7 (ch)	K to K sq
20. Q to Kt8 (ch)	K to K2
21. Q takes P (ch)	K to B sq
22. R takes R	B to B sq

White announced mate in four. 23. R to R8 (ch), K to Kt2. 24. R to R7 (ch), K takes R. 25. Q to B7 (ch), K to R sq. 26. Kt to Kt6 mate.

FIRST PRIZE THREE-MOVER IN THE PROBLEM TOURNAMENT OF THE GERMAN CHESS ASSOCIATION.

BY FRITZ, OF GEJIERSSTANN.

BLACK.



WHITE.

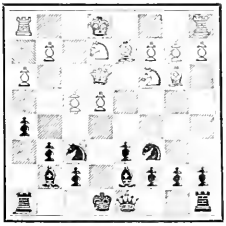
White to play and mate in three moves.

[This is a very beautiful problem. I have ventured to omit the key move, supplied by Mephisto, in the belief that among our Chess readers are many who would prefer to contend with it unaided.—R. P.]

POSITION IN THE GAME BETWEEN PAULSEN AND GUNSBERG.

W. PAULSEN.

WHITE.



BLACK.

GUNSBERG.

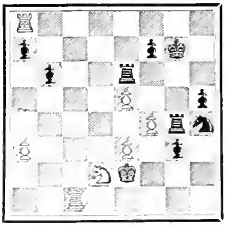
The game proceeded as follows:—

P to K5	P takes P
P takes P	B to R3
Kt to B4	Castles
P takes Kt	R to K sq
Kt to K4	B to B4
Castles QR	R takes Kt
Q to Kt3	Q takes B (ch)
R takes Q	B takes Kt
Q to B2	R to Q sq
R to Q sq	R takes R
R takes R	R to Q5, and won.

POSITION IN THE GAME BETWEEN GUNSBERG AND WINAWER.

WINAWER.

BLACK.



WHITE.

GUNSBERG.

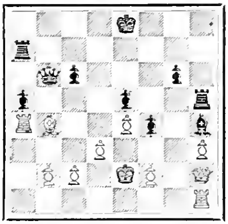
The game proceeded with:—

Kt to B3	Kt takes Kt
K takes Kt	P to Kt7
R (B sq) to B8	R to Kt6 (ch)
K to K4	R (Kt6) takes P (ch)
K to B5	R (K3) takes P (ch)
P takes R	R to B6 (ch)
K to K4	R to K6 (ch)
K to B4, and won.	

POSITION IN THE GAME BETWEEN SCHALLOPP AND GUNSBERG.

SCHALLOPP.

BLACK.



WHITE.

GUNSBERG.

In this position White played as follows:—

KR to QR sq	P to B6 (ch)
K to B sq	QR to KR2
B to Q2	B to B3
R takes P	R takes P
R to R8 (ch)	K to B2
R (R sq) to R7 (ch)	K to K3
Q to Kt sq	R takes R
R takes R	Q takes R
Q to Kt4 (ch)	K to Q3
Q takes R	Q to R8 (ch)
B to K sq	Q to Q8, and wins.

CONTENTS OF No. 90.

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KNOWLEDGE
AN ILLUSTRATED
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LONDON: FRIDAY, AUG. 3, 1883.

Contents of No. 92.

A NATURALIST'S YEAR.

By Grant Allen.

XVIII.—WASPS AND FLOWERS.

On the very summit of the wind-swept heath, scarcely sheltered from the north by a ragged row of straggling Scotch firs, a colony of broom manages somehow to battle hard for life against wind and weather, while on its roots the fat tuberous stems of the greater broomrape have fastened themselves vigorously to suck out whatever little sap the poor drained plants can spare, with all the ruthless, leech-like greediness of born parasites. Broomrape, we call the withered brown weed, in fact, in good old English, for this very reason, because it roots itself firmly on the underground stem of the broom, and violates or plunders it till almost nothing is left of it but bark and wood. It is a tall, wilted-looking thing, this broomrape, so dry, and grey, and faded, that you would hardly take it at first sight for a living flower at all; you would be much more likely to pass it by unnoticed as a sere and withered stalk covered with last year's empty seed-vessels. If you look at it closely, however, you will see that, though it is almost leafless, like most other thoroughgoing plant-parasites (having only thin stem-scales instead of green foliage) it is, nevertheless, a fresh, vigorous, and succulent living spike of dingy blossoms. At this moment, the spikes are all surrounded by belted black and yellow wasps, whom I have often seen hovering before around the dull flowers; for greater broomrape is a wasp-fertilised plant, though the fact seems to have escaped the observant eye even of that most patient and careful of German naturalists, Hermann Muller. Everybody knows, of course, the close connection that exists between bees and flowers; but I don't think most people are aware that there are a few exceptional plants which depend almost entirely upon wasps for the due conveyance of their pollen from head to head; so perhaps I can't do better than take this dingy brown broomrape for the text of a short discourse on this very subject, and point out how far the peculiar æsthetic tastes of the omnivorous wasps have reacted upon the special flowers on which they have concentrated their unconscious botanical efforts.

Wasps, as we have all observed, are very promiscuous feeders. They will eat almost anything they can get, from a good piece of raw beef to a plum or a potato. Hence, like most other promiscuous feeders, they have not acquired any marked taste for beauty of form or colour. As a rule, in the animal world, love of colour is found only among those birds or insects which restrict themselves entirely to honey-sucking in brilliant blossoms or to eating equally brilliant fruits. On the other hand, wasps are not wholly devoid of the flower-haunting habit; for they are very fond of sugar and all other sweets, as we have often noted both in grocers' shops and at our own dessert. So they seek for honey in a few special and peculiar blossoms, which have thus been compelled to adapt themselves to the very low tastes of these uncanny insect allies. Bees are fond of flowers with long tubes, which preserve the nectar from other thieving species; and in order to allure their fastidious eyes, such blossoms have acquired brilliant tints of purple, blue, or crimson, which are very attractive to the honey-loving aristocrats of the insect world. But the wasps care nothing for such beautiful æsthetic displays; they are strictly practical insects, with a decided eye to material advantages, and all they ask is that the flowers they patronise should not play at fox and stork with them, by concealing their nectar at the bottom of a long and narrow tube. Wasp blossoms, in short, must have shallow, open, cup-shaped corollas, just big enough to fit the insect's head, and with abundant honey so disposed that it can be readily abstracted without much trouble by the vespine mouth. They need not be bright-coloured; indeed, brightness of colour, by attracting other insects which are less adapted for fertilising them, would prove actually disadvantageous to the species; so as a class they are the very dingiest and dullest of known flowers, being specially modified, as has been quaintly said, "to suit the wants of an insect circle possessing very uncultivated æsthetic tastes." You could not have a better example of the group than that afforded us by this brown and dry-looking greater broomrape. It is inconspicuous enough to keep away all other insects; and those few venturesome flies that do venture near it, allured by the smell of honey, are sure to be quickly driven off by the sharp jaws and deadly stings of its natural possessors, the wasps.

We have not very many native wasp-flowers in England, but what few we have are quite sufficient to give us a very good general idea of the effects produced by such very special and exceptional selection. The commonest among them are the two fig-worts or scrophularias, which grow abundantly by the water's side. These very odd and uncanny blossoms are shaped so as just to form a hood or helmet for the wasp's head; and when he inserts his mouth into the flower, he rubs the pollen from the stamens last visited on to the forked and bent stigma with unerring certainty. In colour, the corolla of the fig-worts is an indescribable dirty olive brown, with a touch of chocolate red and green in it, not at all pretty, but extremely queer and noticeable. You can't stand by the side of one for five minutes without seeing it visited by at least one wasp, and on bright, sunny mornings you are pretty sure to see half-a-dozen. Another somewhat rarer English wasp-flower is the broad-leaved epipactis, an orchid growing in shady places, and not infrequent on the outskirts of moorland farms. In colour, it is almost the same dingy purplish-green as the fig-worts, and it is arranged so as to form a very similar hood-shaped cap, just fitting the wasp's head. So far as family goes, these two weeds are as wide apart as any two flowering plants can possibly be, for the one is a very advanced monocotyledon, while the other is a highly-modified type of dicotyledon; but their adaptive peculiari-

ties, developed by the selective action of the same wasps, are almost exactly similar. On the other hand, we have in England a second epipactis, confined to marshy situations, and in all essential particulars practically identical with the broad-leaved species ; but it is fertilised by the honey bee, by certain flies, and by some other colour-loving insects, and therefore, instead of being dull purple or brown, it is prettily variegated with pink and white—being, in fact, one of our daintiest and most beautiful native orchids. This case admirably exemplifies the powerful influence of the insect guests on such easily-modified points as colour and dappling. Another wasp-flower which, though not exactly British, has been planted in our shrubberies and borders till it has become practically naturalised, is the snowberry, whose small, round, bell-shaped blossoms and pulpy white fruit are familiar to everybody. By descent the snowberry is a member of the honeysuckle family ; but it has acquired the habit of being fertilised mainly by wasps, and it has adapted itself accordingly to their needs and requirements. Instead of a narrow deep tube like the true honeysuckle, beloved by long-tongued humming-bird hawk-moths, it has got a short, shallow, goblet-shaped corolla, exactly fitted for the accommodation of a wasp's head. In colour the flower is rather pinkier and prettier than the figworts or the greater broomrape, but then it is also more dependent for occasional chances upon other colour-loving insects. It has not yet completely specialised itself for wasps alone, and in some places it is almost equally visited by hive-bees. Lastly, I must not forget to mention the most famous wasp-flower of all, that of the edible fig, whose fruits cannot be properly set without the intervention of a closely-correlated insect ally, known as the fig-wasp. Figs are practically what is called in the technical language of botany, diœcious—that is to say, the stamen-bearing and seed-bearing flowers grow separately on distinct trees, for the female flowers are abortive in some cases, and the male ones in others. Only the female, or fruit-producing trees, are cultivated. The wild caprifico of Italy supplies the complementary males. The fig-wasps lay their eggs in the fruit of the caprifico, and there the young hatch out. Then the peasants hang the caprifico fruits on the fig-tree, so that the wasps, on flying out covered with pollen, may at once enter the young figs. The whole history of these wasps and the figs which they impregnate is a marvellously interesting one, but it is too long and far too complicated to enter into at full length here. It must suffice to note that the fig inflorescence is just as dingy green or dull purple as all the other known wasp-flowers.

THE MORALITY OF HAPPINESS.*

By Thomas Foster.

CONDUCT AND DUTY.

MORALITY relates to those parts of our conduct of which it can be said that they are right or wrong. Under the general subject conduct, then, morality is included as a part. Or regarding the word "duty" as implying all that we ought to do and all that we ought to avoid, we may say that duty is a part of conduct. All actions which are not purposeless may be regarded as included under the word "conduct," as well as some which, though purposeless at the time, result from actions originally done with purpose until a fixed habit had been acquired. But only those actions which we consider good or bad are referred to when we speak of duty ; and the principles of what we call morality relate only to these.

Here, however, we have already recognised a connection between duty and conduct generally, which should show all who are familiar with scientific methods that morality cannot properly be discussed in its scientific aspect without discussing conduct at large. Every student of science knows that rightly to consider a part, he must consider the whole to which it belongs. In every department of science this general law holds, though it is not always recognised. No scientific subject has ever been properly dealt with until it has been considered in its relations to its surroundings as well as separately. Even in matters not usually considered from a scientific standpoint the same law holds. To go no farther than our own pages, the writer who is dealing with the question "How to get strong?" would not consider how the arms are to be strengthened without duly considering that the arms are part of the body, their exercise related to the exercise of other portions, their development associated with the development of other limbs, with the action of other parts of the body, with the regimen proper for the whole frame.

It may not by many be regarded as a *fault* of most systems of morality, that they overlook the necessary connection between conduct in general and conduct as guided by moral considerations. For, many are content to regard moral laws as existing apart from any of the results of experience—whether derived from individual conduct, the conduct of men generally, or conduct as seen among creatures of all orders. With many, morality is looked upon as a whole,—the whole duty of man—not as a part of conduct. They even consider that moral obligations must be weakened when their dependence on conduct in general is insisted upon. Moral rules, with them, are right in themselves and of necessity—and whether inculcated by extra-human authority, or enjoined by law, or perceived intuitively, are open neither to inquiry nor objection. Clearly if this were so, morality would not be a fitting subject for the scientific method. Its rules would be determinable apart from the discussion of evidence based on experience whether observational or experimental. I do not here inquire whether this view is right or wrong. Later on it will fall into my plan to do so. At present I only note that we are considering our subject from the standpoint of those who desire to view morality in its scientific aspect. For them it is essential that as conduct in general includes conduct depending on duty, the discussion of questions of duty cannot be complete or satisfactory unless it is conducted with due reference to the whole of which this subject forms a part.

If any doubt could exist in the mind of the student on this point, it should be removed when he notes that it is impossible to draw any sharply defined line between duty and the rest of conduct not depending on considerations

---

* I remind the reader that in these papers, as stated in the introductory one, I am following the lines along which Mr. Herbert Spencer has already traced the general doctrine of the morality of happiness. Where his reasoning seems open to objection or too recondite to be quite readily followed, I shall indicate such objections, and my own opinion respecting them, or endeavour to remove such difficulties, but the moral doctrine I am here dealing with is that of which he has been the chief teacher, if he may not be regarded as its only founder. Even if the scientific study of Ethics, on principles analogous to those which have made astronomy, geology, and more recently biology, true sciences, has been taken up by others and pursued till new truths have been recognised and perhaps some errors pointed out in his treatment of it, it remains still true that he was the first to indicate the true scientific method, and to show where hitherto it had been departed from even by the founders of the school of philosophy to which he belongs.

of duty. Not only are those actions which under particular circumstances seem absolutely indifferent ound under other circumstances to be right or wrong and *not* indifferent, not only do different persons form different ideas as to what part of conduct is indifferent or otherwise, but one and the same person in different parts of his life finds that he draws different distinctions between conduct in general and conduct to be guided by moral considerations. In the evolution of conduct in a nation, in a town, in a family, or in the individual man, the line separating conduct regarded as indifferent from conduct regarded as right or wrong, is ever varying in position,—sometimes tending to include among actions indifferent those which had been judged bad or good, oftener tending to show right or wrong in conduct which had been judged indifferent.

If moral laws, then, are to be established on a scientific basis, it is essential that conduct at large should be carefully considered; and not conduct only as it is seen in man, but as it is seen in animals of every grade. Thus and thus only can the evolution of conduct be rightly studied; by the study of the evolution of conduct only can the scientific distinction between right and wrong be recognised; from and out of this distinction only can moral laws be established for those with whom the authoritative enunciation of such laws has no longer the weight it once had, those who find no other inherent force in moral statutes than they derive as resulting from experience, and who reject as unreasonable all belief in the intuitive recognition of laws of morality.

We proceed then to consider the evolution of conduct in the various types of animal life from the lowest upwards to man.

THE CHEMISTRY OF COOKERY.

XIV.

By W. MATTIEU WILLIAMS.

BEFORE leaving the subject of caramel, I should say a few words about French coffee, or "Coffee as in France," of which we hear so much. There are two secrets upon which depend the excellence of our neighbours in the production of this beverage. First, economy in using the water; second, flavouring with caramel. As regards the first, it appears that English housewives have been demoralised by the habitual use of tea, and apply to the infusion of coffee the popular formula for that of tea, "a spoonful for each person and one for the pot."

The French after-dinner coffee-cup has about one-third of the liquid capacity of a full-sized English breakfast-cup, but the quantity of solid coffee supplied to each cupfull is more than equal to that ordinarily allowed for the larger English measure of water.

Besides this the coffee is commonly, though not universally, flavoured with a specially and skilfully-prepared caramel, instead of the chicory so largely used in England. Much of the so-called "French coffee" now sold by our grocers in tins is caramel flavoured with coffee rather than coffee flavoured with caramel, and many shrewd English housewives have discovered that by mixing the cheapest of these French coffees with an equal quantity of pure coffee they obtain a better result than with the common domestic mixture of three parts coffee and one of chicory.

A few months ago a sample of "coffee-finings" was sent to me for chemical examination, that I might certify to its composition and wholesomeness. I described it in my report as "a caramel, with a peculiarly rich aroma and flavour, evidently due to the vegetable juices or extractive matter naturally united with the saccharine substance from which it is prepared." I had no definite information of the exact nature of this saccharine substance, but have good reason to assume that it was a bye product of sugar refining.

Neither the juice of the beetroot nor the sap of the sugar-cane consists entirely of pure sugar dissolved in pure water. They both contain other constituents common to vegetable juices, and some peculiar to themselves. These mucilaginous matters, when roughly separated, carry down with them some sugar, and form a sort of coarse sweetwort, capable by skilful treatment of producing a rich caramel such as I received.

I tested its practical merits by making an infusion of pure coffee of fine quality, dividing this into two parts, adding to one a small quantity of the caramel, and leaving the other half unmixed. I found the infusion greatly improved in flavour by the admixture, and recognised the peculiarity which characterises the coffee prepared by Gatti and his compatriots, whose numerous establishments are doing so much for the promotion of temperance in this country. The arema of this particular caramel is peculiarly fine, and the greater part of it is soluble in boiling water; thus I was able to mix it by merely adding to the coffee as we add sugar.

I have used my best eloquence in trying to persuade the manufacturers to sell it separately, but have not yet succeeded. They seem to have had painful experience of the gastronomic bigotry of Englishmen who refuse to eat or drink anything that is not hallowed by the sanction of their great-grandmothers, unless it is surreptitiously introduced by means of some device approaching as nearly as possible to a commercial swindle.

Returning to the subject of frying, we encounter a good illustration of the practical importance of sound theory. A great deal of fish and other kinds of food are badly and wastefully cooked in consequence of the prevalence of a false theory of frying. It is evident that many domestic cooks (not hotel or restaurant cooks) have a vague idea that the metal plate forming the bottom of the frying-pan should directly convey the heat of the fire to the fried substance, and that the bit of butter or lard or dripping put into the pan is used to prevent the fish from sticking to it or to add to the richness of the fish by smearing its surface.

The theory which I have suggested (see No. 13, page 2) is that the melted fat cooks by convection of heat, just as water does in the so-called boiling of meat. If that is correct, it is evident that the fish, &c., should be completely immersed in a bath of melted fat or oil, and that the turning over demanded by the greased-plate theory is unnecessary. Well educated cooks understand this distinctly, and use a deeper vessel than our common frying-pan, charge this with a quantity of fat sufficient to cover the fish, which is simply laid upon a wire support, or frying-basket, and left in the hot fat until the browning of its surface, or of the flour or bread-crumbs with which it is coated indicates the sufficiency of the cookery.

At first sight this appears extravagant, as compared with the practice of greasing the bottom of the pan with a little dab of fat, but any housewife who will apply to the frying of sprats, herrings, &c., the method of quantitative inductive research, described and advocated by Lord Bacon in his "Novum Organum Scientarum," she may prove the contrary.

"Must I read the 'Novum Organum,' and buy another dictionary, in order to translate all this," she may exclaim in despair. "No!" is my reply. This Baconian inductive method, to which we are indebted for all the triumphs of

modern science, is nothing more nor less than the systematic and orderly application of common sense and definite measurement to practical questions. In this case it may be applied simply by frying a weighed quantity of any particular kind of fish—say sprats—in a weighed quantity of fat used as a bath; then weighing the fat that remains and subtracting the latter weight from the first, to determine the quantity consumed. If the frying be properly performed, and this quantity compared with that which is consumed by the method of merely greasing the pan-bottom, the bath frying will be proved to be the more economical, as well as the more efficient method.

The reason of this is simply that much or all of the fat is burnt and wasted when only a thin film is spread on the bottom of the pan, while no such waste occurs when the bath of fat is properly used. The temperature at which the dissociation of fat *commences* is below that required for delicately browning the surface of the fish itself, or of the flour or bread-crumbs, and therefore no fat is burnt away from the bath, as it is by the overheated portions of a merely greased frying-pan, and as regards the quantity adhering to the fish itself, this may be reduced to a minimum by withdrawing it from the bath when *the whole* is uniformly at the maximum cooking temperature, and allowing the fluid fat to drain off at once. When cooked on the greased plate, one side is necessarily cooling, and the fat settling down into the fish, while the other is being heated from below.

The bath-frying, of course, demands separate supplies of fat—one for fish, another for cutlets and other similar kinds of meat, a third for such goody-goodies as apple-fritters—a most wholesome and delicious dish, too rarely seen on English tables. I suspect that the prevalence of the greased frying-pan is the reason of its rarity. Cooked by this barbaric device, apples are scarcely eatable, but when thin slices are immersed in a bath of melted fat at a temperature of about 300° F., the water of their juice is suddenly boiled, and as this water is contained in a multitude of little bladder-like cells, they all burst, and the whole structure is puffed out to a most delicate lightness, far more suitable for following solid meats than soddened fruit enveloped in heavy indigestible pudding-paste. Another advantage is that with proper apparatus (wire basket, stew-pan, and store of special fat) the fritters can be prepared and cooked in about one-tenth of the time demanded for the preparation and cookery of an apple pudding or pie. A few seconds of immersion in the fat-bath is sufficient.

But the fat that has been used several times requires purification. This is especially the case with that devoted to fish-frying. The purification of fat is an important and interesting process that I will endeavour to treat as simply as may be in my next.

*** There is no Editorial Gossip this week for the reason that the Editor's medical adviser recommends cessation for the present from all work not absolutely necessary.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

ALTHOUGH I suppose none of the readers of Knowledge entertain any manner of doubt as to the rotundity of the earth, it is not unlikely I think that some will find the illustrations or proofs of that rotundity which I propose to describe in this and a few following papers, somewhat novel. They have occurred to me during my residence at the seaside in former years and recently, and during my travels over prairie levels in North America, and so far as I know have not as yet found a place in text-books of astronomy. Just now when many readers of Knowledge are at the seaside these methods or some of them will be found especially interesting, since the sea-surface constantly illustrates terrestrial rotundity.

Let me premise that as commonly presented in works on astronomy the proof of rotundity afforded by the appearance of ships as they pass over the horizon limit and beyond, is apt to introduce a serious difficulty, though sound enough in itself. We are shown in a picture entirely out of proportion, a round hill of water over the top of which a line of sight is carried from an observer as at A, Fig. 1, a departing ship being shown in several positions as at 1, 2, 3, 4, fully seen at 1 and 2, hull down

Fig. 1.

at 3, and showing upper part of mast only at 4 to the spectator at A. In such pictures the depression of the line of sight Aa touching the convexity of the water, or the angle aAt which it makes with the horizontal line At, is so considerable as to be obvious. Now the student is thus taught two things,—one true the other untrue. He learns correctly enough how and why a ship disappears beyond the convexity of the sea; but he is also taught what is not correct, viz. that the sea horizon dips observably below the true horizon, and that the depression of the sea horizon becomes obviously greater as the observer's height above the sea-level increases. When the learner is next at the sea-side and notes that there is no such visible depression, nay that when he is a good deal above the sea-level the sea horizon appears (by an optical illusion, indeed, but still very strikingly) higher than when he stood on the seashore, he is apt to think he has been wrongly taught on the other point also.

It was in this way indeed that the small but lively sect of flat-earth men were deceived by the man who under the pseudonym Parallax has borne—for reasons best known to himself—three surnames of more familiar sound, and to this day the peculiarity in question is the one by which his followers are deluded. It cropped up in the notorious Bedford Level experiment by which the wager respecting the rotundity of the earth was decided; and I fancy that to this day, on the strength of this misleading peculiarity the loser of that foolish wager considers that he was most hardly dealt with. The experiment actually made on that

occasion was neat and decisive enough; and *before* the experiment I have not a doubt the loser thought the trial could have but one result. It may serve as one among the "pretty proofs" now to be dealt with, while the delusive experiment which the loser wished to substitute after the matter was settled may also be considered with advantage.

On the Bedford level, where there is a water surface without bend for more than twenty miles, are two bridges as at A and C in Figs. 2 and 3, six miles apart, the water surface between them extending straight from A to C. Supposing the earth's surface plane the straight line A B C (Fig. 2) will correctly represent this water surface. On the other hand if the earth's surface is globular, A B C will be an arc of a large circle as in Fig. 3, the straight line A C falling as A h C.

Now at A a telescope was set up as at t, A t being a given length, say 10 ft. (it really matters not what the length so that the same lengths were used at all the stations). At B midway between A and C a pole of the same length was set up bearing a round disc as at b, B b therefore being 10 ft. On the bridge at C a disc c was set up at the same height of 10 ft. above the water surface. Thus

$$A\,t = B\,b = C\,c = \text{(say) } 10 \text{ ft.}$$

Now it is obvious that if, as in Fig. 2, A B C is a straight line, $t\,b\,c$ is also a straight line; so that the telescope at t directed to the disc c bears also on the disc b. Thus if the earth flatteners were right b and c would lie in precisely the same direction from t, or the disc b if of the same size as c would centrally hide c from view.

On the other hand, if A B C is the arc of a circle, so is $t\,b\,c$ the arc of a circle, of appreciably the same radius; so that the telescope at t directed to the disc c, does not bear on b but on a point k below b, where the straight line $t\,c$ cuts b B.

Let us see what $b\,k$ is, in order that we may see whether we have here a delicate or an obvious and very simple test. We have $t\,k\,c$ a chord to a circle 7,920 miles in diameter, and $b\,k\,B\,h$ produced is a diameter of this circle, bisecting $t\,c$ in k. Hence we have by a well known property—

$$tk^2 = bk\,(\text{earth's diameter} - bk)$$

$$\text{or } (3 \text{ miles})^2 = bk\,(7{,}920 \text{ miles})$$

(for the bk within the brackets can obviously be neglected).

$$\text{Hence} \qquad bk = \frac{9}{7920}\text{ths of a mile.}$$

$$= \frac{9 \times 3 \times 1760}{7920}\text{ ft.}$$

$$= \frac{3 \times 1760}{880}\text{ ft.} \quad = 6 \text{ feet.}$$

It is clear then that the test is a very simple and obvious one. For supposing we have a disc 1 ft. in diameter at b, and a disc 2 ft. in diameter at c, so that seen from t both look equally large, it is obvious that the centre of the disc c will be seen 6 ft. below the centre of the disc b, or the appearance presented will be as at Fig. 4, the distance $e\,f$ being five times $d\,e$ or $f\,g$ the diameter of either disc, while $b\,k$ is six times $d\,e$ or $f\,g$. And though in the telescope the scale on which what is shown in Fig. 4 would be seen may be very small, for a distance of 6 ft. is but small at three miles from the eye, yet the discs would show the displacement distinctly enough. As a matter of fact atmospheric refraction would diminish the distance $e\,f$ by about one-fourth; but this would not affect the aspect of the discs. Manifestly the difference between a single disc such as would be seen if the water surface were plane as in Fig. 2, and the two discs separated by three or four times the apparent diameter of either, would be obvious, even to the eye of the most unpractised telescopist.

This then was a most suitable test, considering that neither of the bettors was an astronomer, and that the umpires were altogether without skill in telescopic work.

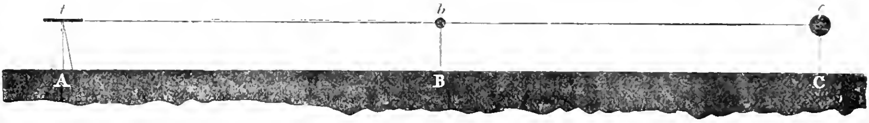


Fig. 2.

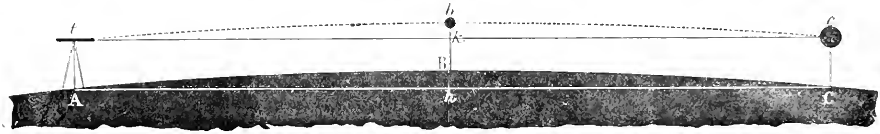


Fig. 3.

Fig. 4.

But when the observation had been made, and the disc at b had been seen well above the disc at c, the loser's umpire, and naturally the loser himself, began to doubt whether the test was right after all. *Could* it be right, to begin with, when it seemed to prove that the loser was wrong and that his money ought therefore to be handed over (as in point of fact it was handed over) by the stakeholder to the winner? No one who knows anything of paradoxical human nature can doubt what answer was given, by the loser, to this question.

The loser's umpire and the loser himself therefore suggested that the test ought to have been different. By some strange perversity they persuaded themselves that even though A B C were straight as in Fig. 2, $t\,c$ should pass below b. *But*, said they, if the earth's surface is really curved, and therefore A B C an arc as in Fig. 3, the telescope at t must be depressed below the true horizon to point towards c, which is true enough; and therefore, if the telescope at t is made perfectly horizontal, by means of a level, *then* it would bear on a point above c; and if there is a point marking the centre of the telescopic field, c ought to be seen below that point. But having, as they assert, correctly and perfectly levelled their telescope, c was not found to be below the central point of the field marked by the intersection of two cross lines. The loser's umpire looked and saw c on the cross hair. The loser found it so too. They therefore not only denied the validity of the other test, but claimed

that the flatness of the water surface was proved and that the sum of £1,000 should be handed to the loser instead of to the winner according to the simpler test.

What they were really doing, only they did not know it, was proposing to substitute a very delicate and unsatisfactory test for a very simple and beautiful one; they were proposing in fact that the advantage given by the use of a mid signal at b, in adding to their instrumental means just what was necessary to make the experiment easy and decisive, should be given up, and a test at once difficult and indecisive substituted for it. This I propose to show next week.

(*To be continued.*)

HOW TO GET STRONG.

REDUCING FAT.

(*Continued from page 50.*)

IN passing let me note that those who are not troubled with undue adipose deposits need not imagine that therefore what is said here about reducing fat can have no interest for them. Most of the plans to which I refer are such as are good for those who wish simply to be strong in body. These methods depend on the avoidance of whatever overtaxes or weakens the system; and though the strong may be able to dispose of an extra amount of food or to resist influences which injuriously affect the weaker, they will be none the worse for following those rules by which the energies of the body are increased, or developed, or saved from being unduly taxed. Yet of course some parts of a system for reducing fat need not be followed by those who have no tendency or little to become obese.

After the food question considered in our last comes naturally the question of sleep which—like food—acts as a restorer of what Nature's wear and tear has removed.

In regard to sleep I take the same line as in regard to food. I consider it unwise to trust wholly or largely in wakefulness and want of rest to reduce fat. That to cut short the hours of sleep does tend to diminish fat is undoubted. The method is a very unpleasant one; but it is effective if one has but energy to follow it. Resolutely limit the sleeping hours to—say—the night hours between eleven and six, and certainly, if you have been in the habit of lying in bed till nine or ten, and perhaps taking a two hours' snooze in the afternoon, you shall find your weight diminishing. You lose weight because you are subjecting the body to a trying ordeal. Seven hours' sleep may be ample for most men, but the allowance is not ample for one who has fallen into the habit of sleeping daily nine or ten hours or more. Punish the body still more by depriving it of sleep and there will be more rapid reduction of weight. But there will probably be other mischief too. Besides, if a man has energy to apply this method, the most distressing of all fat-reducing systems, he can well adopt others, and he will assuredly do well to apply others to do part of the work of fat reduction.

Yet a share of the work can be left to this method—with great advantage all round. An undue amount of sleep is injurious in other ways than in encouraging the development of fat. It weakens the body, dulls the mind, and cuts away a considerable slice of life. Fat folk could not be wrong in steadily resisting and overcoming the habit, even though in so doing they did not—as they will—assist whatever other methods they employ for reducing their weight.

The first step in regulating sleep is to adopt regular hours for it. There should be a fixed time for going to bed and for getting up. Nature presently becomes accustomed to such hours, and then there is no lost time in bed. A man in average health should be asleep a few minutes after his head is on the pillow, and should wake a few minutes before the time which he makes his rising time. It is well to wait till these few minutes after waking have passed; though jumping out at the moment of waking may do very well when the habit of regular rising at a certain hour is first being formed. Immediately after rising it is well to fill a basin three-fourths full of cold water, and to plunge the face and fore part of the head in it several times till nearly out of breath. Recover breath and repeat the process. Again, and yet again. Then dry,—regular washing being attended to later. You are now wide awake, and able also to enjoy being so.

As to afternoon sleep, the rigid would say stop that at once. I do not agree with them. To a man who has fallen into the bad habit of sleeping after a midday meal, suddenly breaking the habit is very trying, and in my opinion mischievous. Careful observation has satisfied me that the evening is passed unpleasantly by one who has thus resisted a habit which though bad has become for awhile a part of his nature. The temper is tried; the sleep at night is not improved; and if after a week or two fat is reduced by this particular part of fat-attacking discipline, it is because the body is punished. One can get rid of fat and other mischiefs without punishing the system.

I would advise those who have fallen into the evil habit of sleeping in the afternoon, to resist each day for a time the heaviness which comes over them at the hour when they are accustomed to sleep. When the effort becomes painful, let them, instead of lying on a sofa or bed, sit comfortably in an arm-chair, loosing collar, cravat, and wristbands (also if necessary the waistband). Then let them sleep for about half-an-hour. I don't mean that they should give folk instruction to waken them, but that they should mentally resolve as they yield to the influence of sleep that it shall be but for half-an-hour or so. Without being wakened they will wake within a few minutes of the time. At least it will be so before long. Then let them stroll to bedroom or lavatory and repeat the face-plunging process as in the morning performance. They will be wide awake, yet all the better for the sleep. As time progresses the sleeping time may be shortened, and probably before long the afternoon nap altogether discarded.

It will be found that the change of diet both in quantity and quality suggested in our last will greatly help in giving mastery over sleep, especially over afternoon sleep. The active exercise advised in what follows may at first encourage the desire for sleep; but not long. By helping to make sleep sounder it will rather tend to shorten the sleeping hours in the long run.

We consider next, however, not exercise, but the treatment of the skin, on the condition of which the value of exercise in great part depends. Probably there is no surer and sounder system of fat reduction than that which is based on due encouragement of the healthy action of the skin.

(*To be continued.*)

Sun-Spots.—Mr. Slack writes that on the 22nd ult. [his letter was unfortunately forwarded to Ventnor, where, in consequence of a railway accident, the Editor was unable to go], in the afternoon, the sun's disk presented an extraordinary appearance; a succession of spots stretched nearly across it, most of them exhibiting a multiplicity of nuclei. There were also three spots isolated from the groups. With such a prodigious line of disturbance, any action which the spot condition may have upon the weather might be expected to be strongly marked.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

It is very common for persons unacquainted with entomology to suppose all the flies of somewhat similar aspect seen on a window-pane are the same sort; the big ones being taken for the grandfathers and grandmothers, and the least for their baby grandchildren. All insects, however, that pass through transformations such as common flies and butterflies do, reach their full size when they emerge from the chrysalis, and do not grow afterwards. Another common mistake is often made towards autumn, when "the flies" are accused of biting, the words implying a belief that the common house-fly gets vicious, or goes mad about that time of the year, which is not the case. Everybody must have noticed that when a house-fly settles upon any substance to feed, it puts forth a horse's head-like proboscis. This is a most wonderful apparatus, and a good way of commencing acquaintance with it is to assist at a bluebottle's dinner. To accomplish this, first catch your bluebottle and keep him under a pill-box or a wine-glass till his meal is ready. To prepare it, crush a bit of loaf sugar the size of a pin's head in a droplet of water. Take a little of the syrup thus made upon the end of a bit of wood—a lucifer match is just the thing—and smear it on the inner side of the glass cover of the live-box opticians usually supply with a microscope. Put the bluebottle upon it, and quickly shut him up by pressing the live-box into the rim of its cover, leaving the fly no room to turn over, but not squeezing him. The box is then placed on the microscope stage and the fly has his under side uppermost. It will soon begin to suck the syrup. The proboscis comes out of a cavernous cleft, the horse's-head end of it opens like two lips, which press against the glass, and the fluid is rapidly swallowed. If it is too thick, the fly can moisten and thin it. It can only swallow fluids, and the wonderful collection of tubes kept open by series of incomplete rings of a hard material act as filters to keep solid particles out. It would take a volume to describe the details of this wonderful apparatus, and no drawings can be made efficient substitutes for seeing the thing itself. The student should dissect such objects with needles set in wooden handles, fine scissors, and a fine, thin-bladed knife. It is also well to buy two slides made by a skilful preparer; one with the proboscis flattened out in the common way, and another mounted in fluid, and not squeezed out of its true shape. The insects can be fed with syrup tinged with cochineal, and the motion of it better seen. No examination of the house-fly or blow-fly will detect any apparatus adapted for biting or piercing a hard substance. In the middle of the proboscis are some teeth fit for scraping a material like moistened sugar, but no saws or lancets, or even knives capable of cutting.

On a hot day in the country, especially near cattle or horses, flies something like bluebottles and house-flies, but with elegantly-mottled wings and splendid green and bronze eyes, are sure to be found. These will take any opportunity of exercising their skill upon the hands or faces of human beings. They are furnished with a proboscis similar to that of the house-fly or bluebottle, and use it in the same way, but their delight is to suck the blood of the animal they torment, and to get at it they have tools to pierce a tough skin. If one of these flies is held in the hand by the wings, and the proboscis is gently poked with a finger-tip, some sharp tools will come out of a fold in its upper side. The males have four, and the females six implements. The latter will be found to possess a pair of Fig. 1, and another pair of Fig. 2, and one each of Figs. 3 and 4, which are pressed together to form a tube. A power of about 25 linear, obtained with an inch and a-half objective, will show the bluebottle at his dinner, and be sufficient to exhibit the form of the knives, &c., of the breeze-fly. A much higher magnification, say 500 linear, shows that an instrument (Fig. 1*a*), shaped like a carving-knife, or sword-bayonet, has its edge very fine and sharp, and the back, for more than half its length, very finely serrated, with the teeth set downwards. As it is pulled back out of a wound it would both enlarge and irritate it. The next tool (Fig. 2*a*) has teeth much like those of a coarse rasp, such as is used upon wood. This can act quickly upon the hides of an animal, and the great central tubular organ has teeth at the top, which a movement of partial rotation backwards and forwards must make a good piercer like a drill.

Fig. 1, × 25.

Fig. 2, × 25.

Fig. 3, × 25.

Fig. 4, × 25.

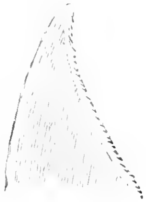


Fig. 1*a*, × 500.

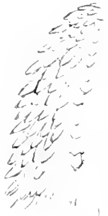


Fig. 2*a*, × 500.

Fig. 3*a*, × 500.

All these instruments should be teased out with needles, and mounted in Canada Balsam. A fly's head, with these organs simply extended, should also be kept as an opaque object. Unfortunately the splendid eyes do not retain their colour, but while fresh are singularly beautiful when strongly illuminated.

To see the bluebottle using his proboscis or trunk, it must be lit up from above. A Lieberkuhn acts well, or a side silver reflector. Beck's is an excellent pattern; but the ordinary form answers well, and best if it is mounted on its own sliding stand and not made to fix on the microscope. Few spectacles are more astonishing than the quick nervous agitation with which the great lips open and shut, and the vigour with which they work.

The mouths of these flies exhibit remarkable departures from the most typical insect pattern, but the comparative anatomist regards their peculiar organs as modifications of simpler forms. Their mouths are called "*antliate*, with a fleshy proboscis (*labium*, or lip), and enclosing several lancet-like organs," so says Westwood of the Diptera in general, but it is only in certain genera that these lancet organs are adapted to hard work. It is instructive to compare the gnat's lancets and saws with those of the breeze-flies (*Tabani*), whose instruments are here figured, and their proboscis with the longer, and in every respect different one of the butterfly and moth. The most formidable of our insect enemies belong to the diptera, as that great group embraces mosquitoes, blow-flies, breeze-flies, gad-flies, &c., in this country, and also the terrible zimb, and the still more dreadful tsetse, whose bite produces a fatal disease in the horse, ox, sheep, or dog.

The modifications of mouth organs in various insects suggests a great lapse of time for their formation by the slow process of descent with modification, and the action of such a fly as the tsetse affords a striking instance of the immense series of changes that may spring from the peculiarities of one small creature. Take away all the animals which the tsetse will not allow to live, and not only is a great country rendered comparatively useless to man, but its vegetation must be different in many particulars from that cropped by herbivora, and manured by their excrements. The poison of the tsetse is very injurious to man, but not nearly so much as to the animals he most needs. Three or four of them are said to kill an ox, and yet the weight of the poison-drops they pour into their victim must be quite infinitesimal. The breeze-flies are not poisonous, but they sometimes attack human beings after their apparatus has been dipt in decomposing filth, and then serious sores result.

NIAGARA.

By Richard A. Proctor.

The brave man who earned a world-wide fame by swimming Dover Straits and had earlier won an even nobler name by plunging into the Atlantic Ocean during storm to save (if so might be) a fellow creature's life, has cast himself a prey to the remorseless waters of Niagara. We cannot now, in the pain and horror excited by the terrible end of his mad attempt, speak as perhaps the stern moralist might speak, of the wrong Webb did his name and fame, the false example he set, by this last use of his splendid courage. We may well believe that he overrated his powers, and underrated (it would be impossible to overrate) the tremendous forces against which he proposed to contend. He maybe did not know, what a rough estimate of the energies at work in Niagara should have shown, that amid that mass of water which descends from the basin below the Falls to the engulfing vortex of the Whirlpool, the body of the biggest and strongest living creature must be as powerless as a drop of water in mid-Atlantic. We may well hope and believe that no weariness of the work of life led him to barter life, or ninety-nine hundredths of his life-chances, against the money by which those dependent on him might live in comfort. We learn that the American railway companies were guiltless, at the last at any rate, of the foul conduct imputed to them; and we may well hope that whatever was said of the sums Webb expected in reward of his exploit, he himself was moved only by the excitement of a contest with forces which other men deemed insuperable, but which he hoped to overcome. Let undue daring be held the only fault in the brave man we have lost. His example, so judged, though not free from blemish, will do little harm, compared at least with what it might have done had fear of life work moved him to his final exploit. Remembering that in his first and noblest achievement he was moved by no hope of gain or even of glory we may well believe that not ignoble thoughts but a lofty though unwise ambition stirred him to attempt the hopeless contest with Niagara in which his brave life was lost.

Lest others, fascinated as he seems to have been by the awful majesty of Niagara, should underrate the fearful power of the forces at work along the course by which the waters of Erie pass to Ontario, or deem that with better luck the Whirlpool Rapids might yet be passed with life—I venture to say a few brief words here about this marvel of nature.

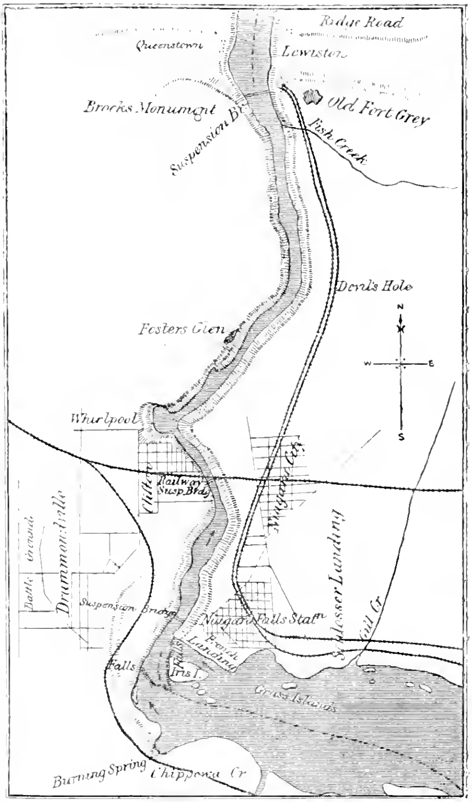


Fig. 1.—THE NIAGARA FALLS, RAPIDS, AND WHIRLPOOL.

The map (Fig. 1) shows the position of the Falls (the Horse-Shoe on the left the American on the right facing directly towards the west), the Whirlpool, and the Rapids,—the Upper Rapids between Iris Island and French Landing, the Lower Rapids between the Suspension Bridge

and the Whirlpool, the Whirlpool Rapids being those just above the Whirlpool itself. Fig. 2 shows in section, enormously exaggerated vertically, the descent from Lake Huron to Lake Ontario,—the River Niagara (Falls, Rapids, Whirlpool, and the quieter parts) being all compressed in this figure in the narrow space shown between Lake Erie and Lake Ontario.

Niagara is wonderful in this that here we have brought before us within a limited space the action of forces usually at work over a far wider area. In comparison with the forces of Nature actually at work in the earth, even during a single hour, the work done at Niagara in many years is almost as nothing. A small quantity of the waters gathered from the higher regions of a small portion of Northern America finds here an outlet, and passes from a level of no great height, by comparison with the elevation of even the smallest mountain ranges, to a height still considerably above the sea-level. Yet because the range of distance within which the descent is accomplished is small, we have a display of nature's energies which impresses, even appals, the thoughtful mind, by presenting concrete evidence of the action of a force of whose might we have usually but abstract indications. To shallow minds Niagara is naturally disappointing, because they cannot even begin to comprehend its significance. To a dull mind the Atlantic and the Andes, the earthquake and the hurricane, are disappointing,—impressing it little more than they would impress a horse or a dog. But the mind which knows something of the language in which Niagara speaks, finds awful, almost oppressive, teaching in the thought that this work which goes on amid deafening uproar and confusing tumult represents not a millionth part of the energies residing in terrestrial gravity,—the force which our mother earth ordinarily uses as if but in play. Here its grim might is seen, and all the more impressively since we know that while it is but the merest nothing of the earth's force which is at work before us, yet we are overwhelmed by its vehemence, powerless in its presence. When the real energies of Niagara have been recognised, and the relation between these energies and the might of terrestrial gravity is understood, the mind must needs be awed, even oppressed, by the stupendous significance of Niagara. We pass from the grandeur of the scene displayed before us to the infinitely mightier terrestrial energies of which it speaks, thence to solar forces before which the whole might of earth is as nothing, and onwards to the starry depths where every point of light is such a sun as ours, until in the black darkness which hides from our eyes the real glories of the universe we recognise the mystery of Infinite Might unknown and unknowable: Lo! these are but a portion of God's ways: they utter but a whisper of His glory; the thunder of His power who can understand?

Professor Tyndall writes as follows in the *Daily News*:—"The 'rapids' proper of Niagara occur above the fall, where for a mile or so the water comes galloping and tumbling down before it takes its final leap over the ledge of the cataract. Below the cataract the river flows through a deep gorge, which has been excavated by the river. At some distance down there is a ferry between the American and the Canadian sides. Lower still is a suspension bridge for foot passengers, while about two miles below the fall

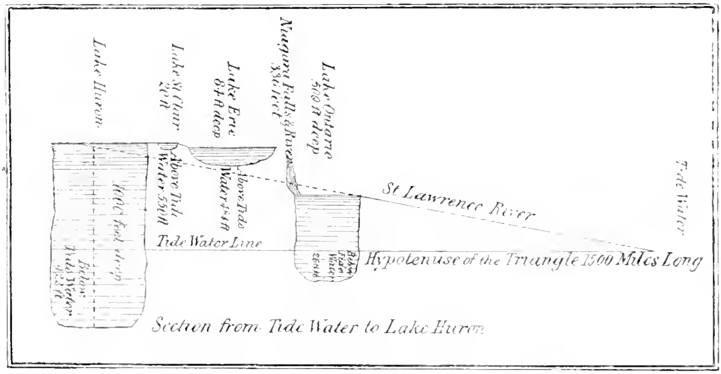


Fig. 2.—WATER SLOPE FROM LAKE HURON TO THE SEA.

the river is spanned by the railway suspension bridge. Between the ferry and this bridge, the river Niagara flows unruffled, but below the suspension bridge the gorge narrows, and the rapidity and turbulence of the water increase. For a certain distance the width can hardly be more than three hundred feet; and here occur what are called the 'Whirlpool Rapids,' which are not to be confounded with the rapids above the fall. It was through the Whirlpool Rapids that poor Captain Webb had to steer his way. It is impossible to describe the wild fury of the waters at this place. I send for your inspection a photograph by Bierstadt, which will give you some notion of it. The river boils and leaps in the most frantic manner, the most extraordinary effect being produced when two waves so coalesce that the united forces of both run on and toss the crest of the compounded billow, shivered into liquid spherules, high in air. In the middle of the river no man could live, and we are informed that Captain Webb avoided the middle. But the tossing everywhere is terrific. Lower down the river suddenly bends nearly at a right angle, and here is formed the whirlpool from which the Lower Rapids derive their name. The river strikes the bank opposed to it with tremendous force, and is thereby thrown into gyratory motion. Here, it is said, Captain Webb lost his life. I do not think a powerful swimmer, with his wits about him, need have come to grief in the Whirlpool itself. But how any man could have kept his senses intact amid the battering and tossing of the

Whirlpool Rapids it is difficult to imagine. It was probably the exhaustion of his power among the rapids that rendered the mighty swimmer unable to escape from the whirlpool. We shall doubtless receive the accurate account of the catastrophe in due time; meanwhile, the recitals in the English newspapers being more or less confused, I thought an approximately accurate description of the scene of the disaster might be of some interest."

Before the event, I wrote as follows in the *Newcastle Weekly Chronicle*:—"Captain Webb is more fitted than most men to battle with surging waves, more practised to maintain such actions as may give him the best chance of safety; but if he escapes his escape must depend on a lucky chance causing his body—necessarily inert to all intents and purposes throughout the beginning of his course—to be carried towards the whirlpool on the least dangerous course, and to be brought under the surface only at intervals enabling him to breathe. No one who has seen the Lower Rapids, and studied the movements of the water there, can fail to recognise that Captain Webb's skill as a swimmer will avail him scarcely anything except at one critical part of his course, which he may perhaps never reach alive. He himself clearly recognises the risks he runs, though probably he has no clear idea of the conditions under which he will be exposed to them. Captain Webb's personal action in the experiment will be akin to the influence of a drop of water on the movements of a great roller in the Atlantic."

The autopsy on Captain Webb's body showed that no bones were broken. There was no wound sufficient to cause death save one, three and a-half inches long in the cranium. This wound was made after death. None of the symptoms of death by drowning were revealed, and it was concluded that death resulted from the shock from the force of the water in the Whirlpool Rapids coming in contact with the submerged body with such force as instantly to destroy the respiratory power, and, in fact, all vital action. The shock was of sufficient intensity to paralyse the nerve centres, partially dessicate the muscular tissues, and forestall death by drowning.

On the Hamburg tramways a number of cars with flangeless wheels, much like omnibuses, and with turning gear, are working. To run on the lines, these cars are fitted with a shaft in front of the front wheels, this shaft carrying on a lever a disc wheel which the driver can lower into the tramrail groove as he requires, or raise it when it is necessary to get out of the way of obstructions. The arrangement works well, saves a lot of trouble, and the cars run easier than those with flanged wheels.

Messrs. Lamplugh & Brown, the well-known saddlers of Birmingham, have recently brought out a new tricycle saddle, which will be preferred by a number of riders to any other saddle at present in the market. The leather is suspended from the opposite ends of the saddle, and supported by a strong, flat, spiral spring, the tension of which can be altered to suit the rider's weight, while ventilation is provided far more efficiently than in any other saddle. The leather seat is slightly cushioned, so as to provide a soft surface to sit upon. At the back of the saddle there is a small upright nickelised support, and in place of the usual back-rest there is attached to this a solid cyclists' wallet, which answers the double purpose of forming a flexible back-rest for the rider and holding the tools, oil-can, or any other small necessaries required on a tour. The whole of the saddle is most ornamental in appearance, and is tastefully got up as well as excellently made.

LAWS OF BRIGHTNESS.

VII.

By Richard A. Proctor.

Zöllner carefully observed the brightness of the superior planets in mean opposition. His results are as follows:—

		Prob. error per cent.
Sun =	6,994,000,000 times Mars	5·8
Sun =	5,472,000,000 times Jupiter	5·7
Sun =	130,980,000,000 times Saturn (without rings)	5·0
Sun =	8,486,000,000,000 times Uranus	6·0
Sun =	79,620,000,000,000 times Neptune	5·5

It follows that, if the total brightness of Mars at mean opposition is set at 1,000, as in my former table, we have the following relative total brightness for the several planets as observed, and as calculated for the case of smooth spheres of equal reflective power:—

	Observed Brightness.		Calculated Brightness.
Mars	1000	...	1000
Jupiter	1278	...	487
Saturn, without rings	53·4	...	24·5
Uranus	0·824	...	0·30
Neptune	0·088	...	0·058

Zöllner deduces for the reflective powers of these planets' surfaces the values—

Mars = 0·2672 Jupiter = 0·6238
Saturn = 0·4981 Uranus = 0·6400
Neptune = 0·4648.

Zöllner's observations of the moon at different phases between the two quarters and full have next to be considered. It is obvious that as the different parts of the moon's disc, when "full," do not shine with the brightness due to a smooth surface, we might expect to find her total brightness at any other phase differing markedly from the value estimated for the case of a smooth sphere. This Zollner found to be the case. The "full" moon is far brighter, by comparison with the gibbous moon (especially when little more than half full) than the relation illustrated in Fig. 10 would indicate. This relation is thus given by Lambert for the moon assumed to be a smooth sphere. Let v be the angular distance of the moon from the sun, then the moon's total brightness varies as

$$\sin. v - v \cos. v$$

After carefully analysing the whole subject, discussing various hypotheses as to the moon's surface-contour, and "averaging" as only a German philosopher can do, Zollner treats the case finally, as though the moon were covered with hills having a slope of 52° (it is not easy to follow him on this point, for his formula does not correspond to the case of conical hills, or prism-shaped hills, or, in fact, hills of any shape with such a slope). But Zöllner is led finally to substitute for Lambert's formula the following:—The moon's brightness, when she is separated by an angle v from the sun varies as

$$\sin. (v - 52^\circ) - (v - 52^\circ) \cos. (v - 52^\circ).$$

This formula cannot, of course, be actually correct, since the expression vanishes when $v = 52^\circ$, whereas we know that the moon's brightness is not zero when she is 52 from the sun. As an empirical formula for the moon's brightness when she is gibbous, however, it serves well, as will be seen by the following table (where the brightness of the full moon is taken as 100):—

v	$\pi - v$	Calculated Brightness. Lambert's Formula.	Calculated Brightness. Zöllner's Formula.	Brightness. Zöllner.
°	°			
179	+ 1	99·98	98·60	98·60
185	5	99·63	92·79	87·20
172	8	99·06	88·41	92·19
169	11	98·24	84·04	88·76
193	−13	97·57	81·21	82·60
161	+19	91·93	72·29	68·41
156	24	92·13	65·15	71·38
153	27	90·18	61·00	57·90
207	−27	90·18	60·93	63·47
152	+28	89·53	59·60	56·15
208	−28	89·50	59·60	57·00
147	+23	85·82	52·90	48·60
219	−39	80·87	45·00	41·70
140	+40	80·01	43·72	47·10
139	41	77·78	42·50	43·95
222	−42	78·27	41·40	38·00
134	+46	74·61	36·70	36·10
232	−52	68·87	27·63	29·11
122	+58	62·91	24·30	27·10
242	−62	58·89	20·60	20·40
249	−69	51·82	15·20	14·60

It is remarkable that Zollner's observations should agree so well with calculations based on a formula which is, on the face of it, erroneous.*

Zollner's work on the brightness of Mars when gibbous led to the strange result that the defalcation of the brightness of Mars when gibbous is greater than in the case of the moon. Instead of an inclination of 52° for the Martian mountains, Zollner inferred an inclination of more than 75°. It must be admitted, I think, that this would be absurd, even though we had reason to believe that the whole surface of Mars is solid, which is certainly not the case. An equally complete, and much more natural explanation, is obtained, if we suppose the Martian air to be ordinarily somewhat cloud-laden, the clouds resembling in shape our own summer clouds, and lying far enough apart to show the Martian surface. This explanation is given and illustrated at p. 65 of my "Essays on Astronomy," where it is shown that as a consequence of the supposed state of things the edge of Mars's disc should appear brighter than the central part, which is actually the case. But I must here note that there is a mistake in what I there say, to the effect that Zollner's observations would be equally well explained by supposing that "when the sun is near the horizon of Mars, heavy mists hang in the air." The aspect of Mars when gibbous at once negatives this subsidiary explanation (as I ought to have noticed when I penned the above words, and as I should have noticed if I had followed my usual rule of reasoning out the matter at the time of writing). For, near the terminator of gibbous Mars the light darkens perceptibly, precisely as it should do if my first explanation be correct (of which I now entertain no doubt); but if morning and evening mists prevailed in Mars, the part near the terminator would be rather brighter than the part near the true limb. Comparing this with my reasoning as to the first explanation, and noting how absolutely untenable is Zollner's theory of sugar-loaf hills all over Mars, it appears to be as nearly demonstrated as the nature of things renders possible that the Martial clouds are for the most part cumulus clouds.

* This table is taken from Klein's "Das Sonnensystem." In the original paper by Zöllner the logarithms of the quantities above tabulated are given, and Klein has been at great pains to substitute the natural numbers. But he fails to notice two mistakes in the original tables, where, opposite 139° and 219°, Zollner sets as the logarithm of the brightness calculated by Lambert's method, 1·9985 and 1·9774 respectively, instead of 1·8985 and 1·9079 respectively. Thus in Klein's table there is given opposite 219° the value 94·93, and opposite 139° the value 99·66 which are obviously erroneous. Here is another instance of *the absolute necessity of examining everything resembling a table* which one may desire to make use of. No one would believe how readily mistakes will escape the notice of even the most careful tabulist. I am satisfied that the very care taken by Klein to make his table instructive caused him to overlook points affecting its general accuracy. It would be unfair not to point this out. There are two ways in which tables may become erroneous:—First, when tables are simply pitchforked into a book by a compiler, one may be tolerably certain that they are erroneous; but secondly, when a careful worker like Klein really gives labour to a table, it will happen that while engrossed on such special work, he overlooks the necessity for general supervision.

(To be continued.)

THE DISCOVERY OF THE CHIEF DIVISION IN SATURN'S RING.

Misled by a categorical statement on page 217 of Breen's "Planetary Worlds," I last autumn wrote to Knowledge (Vol. II. p. 294) to inquire whether a letter written by Wallis to Huyghens, on the subject of the supposed duplicity of Saturn's Ring, was still extant, and, if so, where it was to be found. It was subsequently pointed out by Mr. Herbert Rix (p. 471) that it was not Wallis at all who wrote to invite the attention of Huyghens to what had been seen (or imagined) by William Ball, but the first President of the Royal Society, Sir Robert Moray. I am happy to learn, through Mr. C. Leeson Prince, F.R.A.S., that Moray's letter to Huyghens has been found in the library at Leyden by Dr. Bakhuyzen. The wording of this letter seems to me to be conclusive as to the idea which its writer entertained of the nature of the duplicity of Saturn's Ring, assuming it not to be a single appendage. "Quant au plus éloigné," says Moray, ("la planète Saturne) il y aurait plaisir à découvrir que son corps tourna autour de son axe pendant que ses anses demeurent ferme, et si c'est un cercle comme vous avez prouvé qu'il *pourra bien estre* sans difficulté il ne pouvra avoir aucun mouvement autour du corps du planète si ce n'est qu'il garde tousiours une même plaine. Mais il est temps que vous considerez avec grande attention la figure de ces anses à présent pour voir si vous n'y voyez rien qui vous fasse avouer que ce n'est pas un corps de figure circulaire qui embrasse la disque du planète, mais deux; ce qu'il y aura quelque (word undecipherable) de croire à ce qu'il me semble selon les observations qu'en ont fait le Dr. Ball et son frère tous deux de nostre société, avec un fort bon télescope de 36 pieds." Hence it would seem that Moray was not quite convinced by Huyghens' reasoning that the ring of Saturn was a circle; but rather imagined that each of the ansæ was a separate curve, as shown in the strange drawing—or paper-cutting—by Ball, reproduced in Vol. I. of the "Philosophical Transactions" for 1665 and 1666, and engraved in fac-simile on p. 307 of your second volume. At any rate, it is obvious that neither Ball nor he had the most distant idea that Saturn was surrounded by two *concentric* rings. In the communication from which I have made the above extract, Dr. Bakhuyzen goes on to intimate that Joseph Campani may possibly have seen the outer and inner rings of Saturn, and even "traces of the inner dark ring," and he refers to a figure of the planet by Campani, in justification of this surmise. Mr. Prince, however, has this engraving in one of the numerous early astronomical volumes in his library, and he informs me that no indication whatever of a division in the ring exists in it. So far, then, I would venture to suggest, every attempt to deprive Cassini of the merit (*quantum valeat*) of having

been the first to see the chief division in the Saturnian Ring-system, has broken down utterly.

William Noble.

[I venture to add that in my opinion Captain Noble's conclusion is fully justified by the evidence.—R. P.]

For a long time past actions have been pending between Mr. Bown, of Æolus ball-bearing fame, and various bicycle and tricycle makers. The action against Messrs. Humber, Marriott, & Cooper was concluded on Monday, the 19th inst., and resulted in a verdict for the defendants, Messrs. Humber & Co., with costs. The judge decided in their favour without calling on their counsel to speak. Evidence was produced that three machines had been made and sold with ball-bearings on them similar in construction to Bown's, before the date of Mr. Bown's patents. The decision in this case is likely to prove very important. Many makers will be able to turn out machines at a lower price when they are no longer compelled to pay a royalty on the ball-bearings.

Size of Atoms.—Sir W. Thomson, in a discourse recently delivered before the Royal Institution, has presented the various lines of reasoning which have enabled physicists to estimate the size of molecules. The result has been already made known, but is worth repeating. By four lines of argument it is shown that—with a very high degree of probability—in any ordinary liquid, transparent solid, or seemingly opaque solid, the average distance between the centres of contiguous molecules is less than the 1-5,000,000th of a centimètre, and greater than the 1-1,000,000,000th of a centimètre. Expressed in relation to our more familiar measure the inch, this may, without science even, be represented by saying that the distance in question is less than the 1-2,000,000th of an inch and greater than the 1-400,000,000th part of an inch. If a globe of water or glass, 16 centimètres or 6 1-3 inches in diameter, were magnified to the size of the earth, each constituent molecule being magnified in the same proportion, then the magnified mass would be more coarse-grained than a heap of small shot, but probably less coarse-grained than a heap of 16 centimètre (or 6 1-3 inch) globes.

Newspaper Science.—The following remarkable paragraph appeared in last week's *Electrician*:—The intelligence of the press on technical matters in this country is on a par with that of a baby on soft soap. As soon as an exhibition opens the various papers commence to "report," but the peculiarity remains that the same errors run through scores of reports. One such error in matters electrical is now going the round of the press. We could, if we chose, point out the paper in which the error was made, but it would be impossible to point out the score or so of papers who have faithfully copied the error. Is the Leeds Forge Company's exhibit at the Metal Trades Exhibition lighted by a "storage," or by a primary battery? The papers say it is from a storage battery, and is as successful as it is pleasing in effect, and the result shows the progress made towards independent house lighting from storage batteries. We shall be glad to hear of the firm that claims this storage battery. The lighting may be successful, may be pleasing, may, indeed, be perfect, but whose is the storage battery? We are prepared to maintain, and we think we can prove, that not 5 per cent. of those who report exhibitions ever see the exhibits. [Our opinion of newspaper science is not high, but we feel convinced that the estimated percentage of dishonest reports is exaggerated.]

GREATEST CONTENT WITH PARCELS' POST.

By Richard A. Proctor.

That the new postal arrangements for parcels' delivery have given the greatest content to every British citizen is generally admitted. But I wish now to consider greatest content of another sort. The method of measuring parcels by the new delivery suggests a neat though simple little problem for the solution of which I propose to use the Differential Calculus,—to wit, what is the greatest content of a parcel which can be sent by post.

It is well known of course that if a cylindrical solid has a given height and girth the content will be greatest if the solid is a right circular cylinder. This can easily be shown geometrically. What we have to determine then is this,—Given the sum of the height and girth of a right cylinder, what is its greatest content.

Let h be the height, r the radius of the base, so that the given sum, the length of the measuring tape suggested in the postal directions $= h + 2\pi r = l$ say. Thus $h = l - 2\pi r$. Then

Content of cylinder $= \pi r^2 h = (l - 2\pi r)\,\pi r^2 = \pi\,(lr^2 - 2\pi r^3)$

Differentiating this expression with respect to 0, and equating to zero, we get $\pi(2rl - 6\pi r^2) = 0$

or $l = 3\pi r$

wherefore $l - 2\pi r = \pi r$; *i.e.*, $h = \frac{1}{2}(2\pi r)$

Thus the greatest content with parcels post, is given when the height of the cylindrical parcel is equal to half the girth. This makes the height of the cylinder, or what would usually be the length of our parcel, equal to 2 ft., for greatest content, and the girth equal 4 ft., making the radius of the base 2 ft. π. Putting $\pi = 22\ 7$ this gives radius of the base 7/11ths of a foot, the diameter 14 11ths or $15\frac{3}{11}$ inches, and length 24 inches.

If the parcel is to be a parallelopiped the shape which will give the greatest content may be thus determined :—

Of course the section perpendicular to the length must be a square; let the side of this square be a. Then the total length of the measuring tape being l, the length of the parcel is $l - 4a$; and the content is $a^2(l - 4a)$.

$$a^2 l - 4a^3.$$

Differentiating this expression with respect to a and equating to zero, we have—

$$2la - 12a^2 = 0$$

$$a = \frac{1}{6}l$$

$$\text{Thus the girth} = \frac{2}{3}l, \text{ or } 4 \text{ ft.}$$

The parcel therefore must be 2 ft. in length or height, and 1 ft. in breadth and thickness, or have a section 1 ft. square.

The greatest solid content, then, by the new system is 2 cubic feet, for a flat-sided parcel. The actual maximum content is given in the case of the cylinder, the content of which is $\frac{1}{2} \times \frac{7}{11} \times 4 \times 2 = \frac{28}{11} = 2\frac{6}{11}$ cubic feet.

Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the metropolitan water companies and by the Tottenham Local Board of Health during May last was: — Kent, ·9; Colne Valley, 1·0; Tottenham, 2; Chelsea, 2·1; New River, 2·1; Grand Junction, 2·6; East London, 2·9; West Middlesex, 3·0; Southwark, 3·2; Lambeth, 3·6.

THE FACE OF THE SKY.

From August 3 to August 17.

By F.R.A.S.

A PERIOD of seemingly renewed solar activity renders the study of the Sun's surface very interesting just now; and no clear day should be allowed to pass without directing the telescope to his face. A representation of the night sky during the next fourteen days will be found in Map VIII. of "The Stars in their Seasons." Mercury sets after the Sun during the whole of August, and may possibly be caught with the naked eye over the W. by N. part of the horizon before 8 p.m. Venus is, for our present purpose, invisible. Mars rises before midnight half way between the N.E. and the N.E.-by-E.; but he only looks like a bright red star. Jupiter will not come into view until later. Saturn, though, rises between 11 and 12 p.m. during the earlier part of our specified period, and between 10 and 11 p.m. during the latter part of it. His ring is now so open as to be discernible in a comparatively small telescope. Between the 9th and the 11th of August, and notably on the night of the 10th, the Earth passes through a stream of those curious meteorites which become visible to us on entering our atmosphere as "shooting stars." Their apparition on the 10th gained for them the appellation of St. Lawrence's tears. They are now less poetically, but more scientifically, known as the Perseids, from the fact of their paths all seeming to radiate from a point in the constellation Perseus, forming a triangle with η and γ in that constellation. As a rule, they leave more or less marked trains of light in their wake. The most remarkable thing in connection with this stream is, however, the fact that it travels in the orbit of a small comet (II.) discovered in 1862. Unfortunately, it will be moonlight during the earlier part of the night of the 10th, but not during the whole of it. One occultation of a star by the Moon only will be observable during the fortnight covered by these notes. It will occur on the evening of August 15, when the $5\frac{1}{2}$ mag. star ρ^2 Sagittarii will disappear at the Moon's dark limb at 7h. 25m., at an angle of 49° from her vertex, reappearing at her bright limb, at a vertical angle of 297°, at 8h. 32m. p.m. The Moon's age at noon on August 3 is 0·4 days, and quite obviously, 14·4 days at the same hour on the 17th. She leaves Cancer about 4 o'clock this afternoon, and passes into Leo, where she remains until about 2 p.m. on the 4th, at which time she crosses into Sextans. She takes until noon on the 5th to travel through this, and then re-enters Leo, which she finally quits at 2 p.m. on the 6th for Virgo. It occupies her until noon on the 10th to traverse this great constellation, and at that time she passes over the boundary into Libra. There she remains until about 1 a.m. on the 12th, when she enters the northern part of Scorpio. It takes her about 13 hours to traverse this, and then at 2 p.m. on the 12th, we find her in the southern part of Ophiuchus. Across this she travels, and enters Sagittarius about 8 a.m. on the 14th. She does not reach the confines of Capricornus until 6 p.m. on the 16th, and at 10 o'clock the next morning moves into Aquarius. We there leave her.

Paradox Column.

[The following certainly seems worthy of a place in this column. —R.P.]

A NEW THEORY OF COPERNICUS.

To Mr. R. A Proctor Astronomer

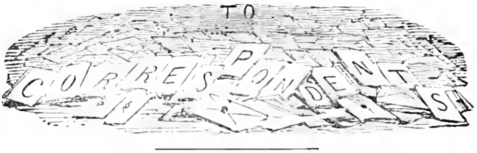
Sir. It appears you are estimated to be a star of the first magnitude in astronomical circles. therefore I beg to introduce to you a few practical proofs that the Copernican theory is the greatest. because the most popular delusien under the sun. being by trade a carpenter I know what a true triangle is. I have also had some experience in leveling building by the herizon of the sea. which by a long straight ridge of a building may be seen to be perfectly straight and level for at least 30 miles. therefore. Can you explain the mystery How it is possible if the earth were a globe 8,000 miles in diameter. for the visible horizon to present an unmistakable straight and level line for 30 or 40 miles. and at the same time be sufficiently convex in 20 miles to hide from view the top masts of a ship some of which is no less than 140 ft high. ? Do the sea rise 140 ft in the centre of 20 miles. ? if so How can 30 miles of sea be a straight line. ? There is also a mystery respecting the supposition distance of the sun from the earth. Do the rays of the sun shine forth direct from the sun to the earth. if not. Can you explain what prevents their doing so. ? But. if the rays come direct. the visible oblique line of the sun's rays. testifies that the now popular supposition distance of the sun from the earth is more than 91.996.000. miles distance from the truth. which is truly a distance of no mean importance. when we consider that on it is founded and being reared up the greatest antagonistic heresy to the source of Englands greatness that history has on record. An important question may truly be asked. Was Copernicus the Anti-Christ. ? The question is worthy of your careful consideration. and even refutation if its in your power to do so. the question may surprise you. and well it may. when you consider the marvellous rapidity with which the supposition theory have spread itself over the face of the whole civilised world.

It has come in the latter days. with haste. even as a cloud covering the whole land with gross spiritual darkness. It has risen out of the sea pure and simple. it requires no mystifying of the text to prove its truth. It is in direct antagonism to the Spirit of the Bible from Genesis to Revelation. It have extended its influence over the whole civilised world. It have made rich many merchants of the earth. It have made war with the Saints and overcome them. Its advocates are constantly conjecturing something contrary to their predecessors. and publicly exposing their suppositions to be what they really were. hypothetical suppositions and nothing more.

The foregoing characteristics are essentially the unmistakable prophetic characteristics of the Anti-Christ. and his numerous followers. they really agree in nothing except in trying to prove the Bible untrue. their suppositions is in reality as unmixable as iron and clay. The theory presents mysteries greater than any other known invention under the Sun. Therefore. I am open to prove in any paper you may name. that the theory is a delusion from three seperate positions. First. from the Bible. Second. from the provable Level surface of the sea. and Third from the provable distance of the sun from the earth by Architectural measurements on the unerring triangulation principle. and I hereby challenge you or any other man to produce proofs (in the same paper) in favour of the theory First from the Bible. Second. from the convex surface of the sea. and then produce your proofs that the Sun is 3 million or 95 million miles distant from the earth. which of the two distances you may imagine has the greatest number of substantial proofs. and in honour of Truth let the winner of the challenge be the one who has the greatest number of substantial proofs in two out of the three suggested positions. an early answer will oblidge Yours Resptly. Wm. Hardy.

St. Helens. Isle. of. Wight.

[It will be shown next, I suppose, that in Knowledge with its far-wandering editor, sub-editor, and staff, its motto "Let Knowledge grow from more to more," and its monthly increase, there is clear evidence of the approach of those latter days when, we are told, "men shall run to and fro and Knowledge shall be increased." —R. P.]



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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DRESS REFORM (CORRECTIONS).

Sir,—May I ask you kindly to allow me to fill up two omissions in my article on "Dress Reform." The first occurs in the quotation from my lecture. Between "decked out in beautiful colours," and "to which it has no claim," should be "which has given it a pretension to beauty."

The second omission makes the continuation of my paper almost unintelligible, as the argument chiefly hinges on the words left out. The 5th requirement, as laid down in the circular of the Association is, "not departing too conspicuously from the ordinary dress

of the time." The omission of the words "too conspicuously" completely alters the meaning of the sentence. E. M. KING.

[We gladly give Mrs. King's letter insertion. The omission of the words was due to a printer's error.—R. P.]

OLDEST HISTORICAL TREE.

[891]—In answer to "Cosmopolitan," the Bodhi tree at Anaradhapuree, Ceylon, is the oldest *historical* tree in the world—not the *oldest tree*. That at Buddh Gaya, near Gaya, from which it was taken, was destroyed, and two or three of its successors also destroyed. The first destruction took place under the orders of Asoka's Queen. The present tree is quite young. I send you herewith a printed account of my visit to it two years ago.

K. S. MACDONALD.

LETTERS RECEIVED, AND SHORT ANSWERS.

M. DOUBLEDAY. Evil all the time, is there not?—R. THOMSON. It would be difficult to say what the capsizing influence of the current would be on a ship launched as the *Daphne* was.—S. J. POTTER. Foretelling destiny by aid of planets sheer nonsense now-a-days, but a not unreasonable notion in old times; the most respectable of the old superstitions.—R. F. KERR. If I could define that word, I should know something indeed. "Can'st thou by searching," &c., they said in old times; so must all say, throughout all time.—E. B. would be obliged if "Pédestrienne," through KNOWLEDGE, would say where the pattern she speaks of, with instructions for making up, can be obtained.—Z. I should say, and so says the writer of the articles in question, a manifest swindle. You will find no chemist to make up the prescription sent you, so must send to advertiser, who charges an exorbitant sum, for a draught possibly worthless, but most probably exceedingly harmful.—W. WOODS SMYTH. *Does* Mr. Herbert Spencer's rule for moral action enjoin us to seek our own happiness supremely? You astound me! *I* thought there was precisely that principle of equilibration in his system of ethics which there is in his system of philosophy generally. Really he seems to say so. But perhaps he does not know his own meaning. Let us wait to see what Mr. Foster makes of it. *Only*, frankly, if Mr. Foster should work out your result, or anything so remote from Mr. Spencer's own teaching, the editor will interfere in a very summary manner with his friend Mr. Foster's series of papers. This is not likely, though.—THOS. WESTLAKE. Out of your own mouth (or from your own pen) you shall be judged. "When will men see," you ask, that there are two revelations of God, one in his works, and the other in his Word? We cannot perhaps always see at once how they harmonise. But we answer they *do*, and we shall by-and-by know how." Yet you are sorry that a series of articles should appear in these pages, the object of which is in the main, as I understand Mr. Foster's purpose, to show that practically the same moral laws result from natural processes affecting the condition and progress of God's work—man—which have been enunciated in those works which you regard as His word. Your contention is unreasonable.—E. C. H. I had the pleasure of conversing with several representative members of the Worthing audience, and think you are mistaken. Friends who were in the audience think so too. Though of course there were many there of the class you mention.—G. S. Question considered.—LEONARD BROWN. Shelley there obviously attacks the argument from design, but his suggestion of the line of reasoning followed later by Mr. Herbert Spencer (the real originator of the environment doctrine) is too vague to be regarded as an anticipation.—J. RUSSELL, B.A. Question does not admit of a solution as stated.—INQUIRER. Two or three months ago the problem of 21 school-girls was solved in a systematic way; easily extended to the case of 15. The problem is not in any case a simple one.—E. BARTON. Certainly hope to give a course of six evening lectures in Manchester before I leave England.—W. H. B. RANINE(?). I believe the flat earth men have no knowledge of what has been done in the way of Antarctic exploration.—C. THOMPSON. An instrument for assisting the hearing was invented by a Chicagoan a few years ago; it was a tautened surface of card or tin, japanned, and held by a handle with the middle of the outer edge between the teeth. As nearly as I can remember, it was about as large as a medium-sized fan. Possibly some reader may be able to give an account of it.—E. W. TAWOM (?). Thanks; but the conjuring trick rather complex.—H. C. JONES. In that sense I am already a member of your "Society for correcting, detecting, and where necessary exposing slander." Much obliged for your very kind remarks about my Southampton lectures, and your report of the kindly acceptance they met with from your friends. We lecturers are supposed to be so possessed with the sense of our constant rightness, and the eternal fitness of all we say and do, that we ought not to hear of any kindly things said of us,—whereas as a matter of fact we are a race of "nervous, shy, low-spoken men" like the Coxswain of the "Mantelpiece," and "not to be treated unbenignly" as Tennyson puts it.—C. J. R. RICHARDS. Those who often tell you that geology disproves evolution because in the lowest fossiliferous rocks animals of a higher organisation have been found than in the upper rocks, should often study a little geology. The statement is untrue in every sense except thus far that just as at the present time there co-exist higher and lower organisations, so has it been in past times; and some of the organisations of an older epoch are necessarily higher than some of the organisations of a later one, even of the latest of all, the present.—A STUDENT. Quite unable to answer such questions; it would afford a bad precedent, and moreover lead to a great deal of annoyance.—HUGH CLEMENTS. "Great earth dominating planets." Great earth dominating fiddlesticks!—J. W. C. "Say about one inch apart,"—all right, I say that: but I do not say what the power of your telescope is. Seriously, one such question answered here would bring a hundred; each of these many more, and KNOWLEDGE would be killed by kindness—its editor's.—H. T. PERRY. Thanks: but matter hardly important enough to be re-opened.—J. GREEVES FISHER. Yes: but your account of the puzzle does not tell us what would happen if some other number than "one" were thought of.—S. M. B. It should be tolerably obvious that Mr. Ledger and I both made the same blunder, speaking of the day as shortening instead of lengthening, though elsewhere we had each carefully shown that it is lengthening, and how, and why.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART X.

Let us next try a problem which is the converse of Example 5.

Ex. 13.—*To determine the greatest of all the triangles which can be constructed upon a given base and with a given perimeter.*

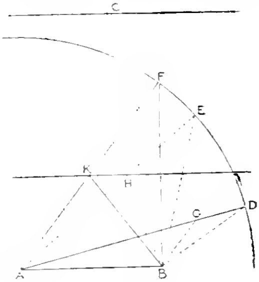


Fig. 21.

Let A B, Fig. 21, be the given base, C the sum of the remaining two sides.

Now, with a knowledge of the property established in Ex. 5, it is of course very easy to see what is the solution of our problem. But we shall assume that the student is dealing with the problem independently. With centre A and radius equal to C describe the arc D E F, and draw radii A D, A E, and A F. Then if from B we draw lines B G, B H, B K in such a way that B G is equal to G D, B H to H E, and B K to K F, it is obvious that each of the triangles A G B, A H B, A K B has the required perimeter. Now it is an obvious consideration that if B G is equal to G D the angle G B D is equal to the angle G D B (we here draw in B D) and, therefore, that in order to draw B G so as to be equal to G D, we have only to make the angle D B G equal to the angle G D B. So that having a *construction* for determining any number of triangles, it is presumable that we shall find materials for determining the triangle of maximum area. But first let us see if anything is suggested by an examination of the figure. We see first that the triangle gradually increases as the angle at A increases. But there is clearly a limit to this increase. For it is obvious that we might have taken B as the centre of a circle with radius C, and thus have shown that the triangle increases as the angle at B increases. We

are led, therefore, at once to the consideration that our triangle will have its greatest area when the angles at A and B are equal.

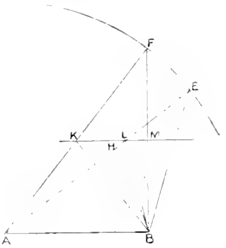


Fig. 22.

To see whether this is the case, we construct a new figure (Fig. 22), in which we omit all unnecessary parts of the former figure, and draw A K F, so that when the triangle A K B is completed, the angle K A B shall be equal to the angle K B A. We then draw K L M parallel to A B, knowing that it is on the distance of this parallel from A B that the area of the triangle A K B depends. We take A E pretty near to A F (seeing that the triangle has obviously *nearly* a maximum area when the angles at A and B are equal, so that any great departure from equality makes the triangle considerably smaller). Let A E intersect K L M in L. Then, if we can show that B H, drawn as before, falls between B A and B L, our surmise will have been proved to be correct. Now the angle H B E, by our construction, is equal to the angle H E B, therefore we must show that the angle L B E is less than the angle L E B, or L E less than L B (Euc. I., 19); therefore, adding A L, we have to show that A E (or C) is less than A L, L B together. This is the problem dealt with in Example 5, and thus the rest of the work corresponds with the work in that example. We find that A L and L B are together greater than A E, so that H *does* fall below L: and the triangle A K B is greater than the triangle A H B. Our surmise is, therefore, shown to be correct, and the problem is solved.

It will be noticed that a problem in maxima and minima loses a large part of its difficulty when, as is usually the case, we are merely asked to prove that such and such relations supply a maximum or a minimum. In the case of Example 13, indeed, inspection supplied a tolerably obvious solution, but this seldom happens. Presented in the usual form, the above problem would run.

Of all triangles on a given base, and having a given perimeter, the isosceles triangle is the greatest.

Thus given, the problem reduces immediately to the case of Example 5.

Example 13 fitly introduces the following, which belongs to a class often found perplexing:—

Example 14.—Of all triangles having a given perimeter, the equilateral triangle is the greatest.

The difficulty in a problem of this sort resides in the fact that we have three elements to consider, all of which admit of being changed. In Example 13 we only had two sides to consider, and when a length had been selected for one, the other was determined at the same time. In Example 14 we have three sides, and must assign lengths to two before the final condition of the triangle is determined. This would be found to afford no assistance towards the solution of the problem. The way to proceed is to assign a length to one side, provisionally, and then to consider what relation must hold between the two remaining sides, whose sum is now assigned,

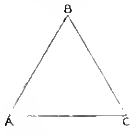


Fig. 23.

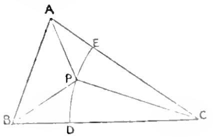


Fig. 24.

in order that the triangle may be as large as possible. This we have learned already from Example 13. Those two sides must be equal. Hence, whatever side we suppose assigned, the remaining two must be equal, to make the area of the triangle a maximum. Therefore, obviously, the triangle must be equilateral. The proof of this would run as follows:—

Let A B C (Fig. 23) be the triangle having the greatest possible area with a given perimeter. Then A B C must be the greatest possible triangle on a given base B C and with the sum of the remaining sides equal to the sum of B A and A C. Hence B A is equal to A C. But also, A B C is the greatest triangle on the base A B with the given perimeter; hence, as before, A C is equal to B C. Therefore A B, B C, and C A are all equal.

As another instance of the application of this important method, we give the following:—

Example 15.—A B C (Fig. 24) is an acute-angled triangle. It is required to determine the position of a point P within the triangle, such that the sum of the distances P A, P B, P C, shall be a minimum.

Assume P to be the required point. Then P A, P B, and P C together have a minimum value. Therefore, also, P A and P B have the least sum they can have *so long as the length of P C remains unchanged:* so that if we draw the arc D P E with radius C P and centre C, A P and P B are together less than the sum of any two lines which can be drawn from A and B to meet on the arc D P E. Hence (Example 11, Cor.), A P and P B are equally inclined to C P. Similarly A P and P C are equally inclined to B P. Hence the angles A P B, B P C, and C P A are all equal, and each, therefore is one-third part of four right angles.

Our Chess Column.

By Mephisto.

SCORE OF THE NUREMBERG INTERNATIONAL TOURNAMENT, ON SATURDAY THE 28TH JULY, 1883.

Names.	Bardeleben	Berger	Bier	Bird	Blackburne	Fritz	Gunsberg	Hruby	Lange	Leffmann	Mason	L. Paulsen	W. Paulsen	Riemann	Schallopp	Schottlander	J. Schwarz	Weiss	Winawer	Total score
Bardeleben	—	1	1	0	½		1	0	1	1	½	½	1		0	½	1	½	0	9½
Berger	0	—	1	½	½	½	1	½	1	1	½	½		½		½	1	1	0	10½
Bier	0	0	—	0	0	½	1	½	1	1	0	0	1	0	½	1	1	½	0	8
Bird	1	½	1	—	0	½	½	1	1		0	1	1	1	0	0	½	1	0	10
Blackburne	½	½	1	1	—	1		1	1	½	0	½	1	1	0	½	1	1	1	12½
Fritz		½	½	½	0	—	0	0	0	½	1	½	1	0	1	0	0	0	0	5½
Gunsberg	0	0	0	½		1	—	0	0	1	0	0	1	0	0	0	½	0	1	5
Hruby	1	½	½	0	0	1	1	—	0	1	½	½	½		0	½	½	½	0	8
Lange	0	0	0	0	0	1	1	1	—	1	0	0	0	½	0	½	0	0	0	5
Leffmann	0	0	0		½	½	0	0	0	—	0	1	0	0	0	½	0	½	½	3½
Mason	½	½	1	1	1	0	1	½	1	1	—	1	½	½	½	1	½	½	0	12
L. Paulsen	½	½	1	0	½	½	1	½	1	0	0	—		0	0	½	0	1	0	7
W. Paulsen	0	½	0	0	0	0	0	½	1	1	½		—	0	1	1	½	½	0	6½
Riemann		½	1	0	0	1	1		½	1	½	1	1	—	1	½	0	½	½	10
Schallopp	1		½	1	1	0	1	1	1	1	½	1	0	0	—	0	0	1	0	10
Schottland'r	½	½	0	1	½	1	1	½	½	½	0	½	0	½	1	—	½	0	0	8½
J. Schwarz	0	0	0	½	0	1	½	½	1	1	½	1	½	1	1	½		½		9½
Weiss	½	0	½	0	0	1	1	½	1	½	½	0	½	½	0	1	½	—	1	9
Winawer	1	1	1	1	0	1	0	1	1	½	1	1	½	½	1	1		0	—	13

As will be seen from the score table published, this great tournament is all but concluded, Winawer being at the head of the list, and Blackburne and Mason following close behind. To speak of Winawer's play as being absolute best would be doing injustice to Blackburne, than whom none in this Tournament have played finer games—a fact acknowledged by all other competitors. Winawer, however, is fond of originality. He generally avoids the known openings by playing P to Q3. As second player he also developes great resources in difficulties. As a notable instance of this may be cited his game with Hruby, one of the most complicated games in the Tournament. At the adjournment the position stood very unfavourably for Winawer, in spite of his being a rook to the good, and it was the general impression that he would lose. Nevertheless, he scored a comparatively easy victory.

Blackburne, who defeated Winawer, has played several games in which, for powerless play in one given position, he has played in matchless style; but he has erred in some instances in judgment of position, which cost him the first prize, notably in his game with Mason, when he repeatedly avoided the draw in a position slightly in his favour, and finally lost. This is a quality in play which reflects credit upon him to the disadvantage of his score. The fact

of his having made several draws is owing to the strength of his competitors, his last draw being with Schottlander, a young player who combines rapidity and ingenuity of combination with considerable experience in tournament play.

Mason has played carefully, the climax being reached on Saturday, when W. Paulsen began with 1. P to QB3, to which Mason replied with 1. P to K3, to the general amusement of the lookers on. The game ended in a draw. Mason and most of the other players favoured the early advent of the QB in the close games on the Queen side.

Bird has played some very fine games, notably one with Riemann, who has improved very much. Bird has, however, lost a game to Mason, in which he adopted his favourite defence to the close openings of P to KB4. In this game he had a superiority in the opening which, by careful play, ought to have enabled him to win the game.

Gunsberg in the first week's play scored 5, defeating Winawer amongst others. He, however, strange to say, entirely broke down in the second week, neither winning nor drawing a game, nor even making any considerable show of resistance, but falling an easy victim to his antagonists. A notable example is his game with Berger, in which, after a well-conducted attack, he missed victory when within easy reach.

The committee have been true to their promise, and rendered the stay of the players as pleasant as possible. Foremost amongst the entertainments provided was a special grand theatrical performance, given in honour of the chess-masters, in which a game with living pieces was played instead of a ballet. Every player will certainly keep in pleasant recollection the third congress of the German Chess Association at Nuremberg.

Nuremberg, July 30th.

The Tournament was concluded to-day by Winawer taking first prize, having defeated Schwarz; score 14. Blackburne, 13½, is second; beat Gunsberg. Mason, 12, third. Berger, 11½, beat Schallopp, is fourth. Bardeleben, 11, fifth, beat Fritz. Bird, 10½, and Riemann, 10½, are sixth and seventh. Schallopp, 10, is eighth; while Schwarz, 9½, takes ninth prize.

GAME BETWEEN BIRD AND RIEMANN, PLAYED JULY 28TH, 1883.

White (Bird).	Black (Riemann).	White (Bird).	Black (Riemann).
1. P to KB4	P to Q4	12. Q to K sq.	R to Q sq
2. P to K3	P to QB4	13. R to B sq.	B to Q3 (b)
3. Kt to KB3	Kt to QB3	14. Q to Kt3 (c)	R to KKt sq (d)
4. B to KB5	Q to Kt3	15. Kt takes P	P takes Kt
5. P to B4	P takes P (a)	16. B takes Kt	R to QR sq
6. B takes P	P to K3	17. QB tks QKtP	K to B sq
7. Kt to B3	Kt to B3	18. B to K5	R takes P
8. Castles	P to QR3	19. R takes P (e)	P to B3
9. P to QKt3	Q to B2	20. B takes Kt	P takes B (f)
10. B to Kt2	P to QKt4	21. P takes P	B takes R
11. B to K2	B to Kt2	22. Kt to Q4 (ch)	Resigns (g)

NOTES.

(a) This brings White's Bishop into good play; either P to QR3 or P to K3 was advisable.

(b) Having regard to the dangerous position of the White QB bearing on the KKt file, B to K2 would have been safer.

(c) A very good move, which prevents Black from Castling on account of Kt to K4.

(d) This, of course, loses on the move, but Black hardly had a satisfactory reply, excepting, perhaps, B to K2, followed by R to Kt sq if Q takes P.

(e) White plays in very fine style. Black cannot prevent the impending dissolution.

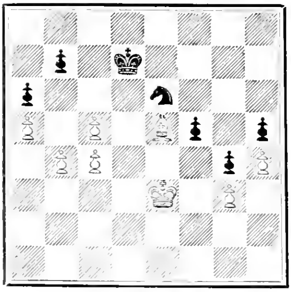
(f) If B takes B, then Kt to Q4 wins.

(g) A fine finish to this well-played game, if K to K2 then Q to Kt5, mate.

POSITION IN GAME BETWEEN BLACKBURNE AND WINAWER.

WINAWER.

BLACK.



WHITE.

BLACKBURNE.

The game proceeded with—

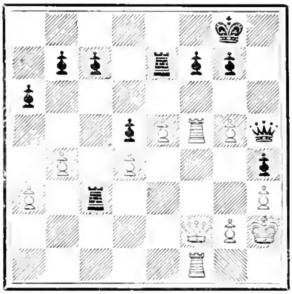
B to Kt8	K to B3
B to Q6	P to Kt4
RP takes P en pas.	K to Kt2
B to K7	P to B5 (ch.)
P takes P	P to Kt6
P to B5	Kt to Q5!
K takes Kt!	P to Kt7
K to Q5	Resigns

If P to Kt8 (Queen), P to B6 (ch). K takes P (best), B to B5 (ch) and wins.

POSITION IN A GAME BETWEEN SCHOTTLÄNDER AND SCHALLOPP.

SCHALLOPP.

BLACK.



WHITE.

SCHOTTLÄNDER.

In this position White played—

P to K6	P takes P
R to B8 (ch)	K to R2
Q to Q2	R to KKt6
Q to B2 (ch)	P to Kt3
Q to B2	Q takes P

Q to B7 (ch), mates in two moves.

CONTENTS OF No. 91.

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AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 10, 1883.

CONTENTS OF No. 93.

VESUVIUS AND ISCHIA.

By Richard A. Proctor.

THE following passages from an essay on Vesuvius, in my "Light Science for Leisure Hours," may prove of interest just now, when Vesuvius and Ischia have shown the close connection which exists between them.

"In the volcanic region of which Vesuvius or Somma is the principal vent, we have a remarkable instance of the deceptive nature of that state of rest into which some of the principal volcanoes frequently fall for many centuries together. For how many centuries before the Christian era Vesuvius had been at rest is not known; but this is certain, that from the landing of the first Greek colony in Southern Italy, Vesuvius gave no signs of internal activity. It was recognised by Strabo as a volcanic mountain, but Pliny did not include it in the list of active volcanoes. In those days, the mountain presented a very different appearance from that which it now exhibits. In place of the two peaks now seen, there was a single, somewhat flattish summit, on which a slight depression marked the place of an ancient crater. The fertile slopes of the mountain were covered with well-cultivated fields, and the thriving cities Herculaneum, Pompeii, and Stabiæ stood near the base of the sleeping mountain. So little did any thought of danger suggest itself in those times, that the bands of slaves, murderers, and pirates which flocked to the standards of Spartacus found a refuge, to the number of many thousands, within the very crater itself.

"But though Vesuvius was at rest, the region of which Vesuvius is the main vent was far from being so. The island of Pithecusa (the modern Ischia) was shaken by frequent and terrible convulsions. It is even related that Prochyta (the modern Procida) was rent from Pithecusa in the course of a tremendous upheaval, though Pliny derives the name of Prochyta (or "poured forth") from the supposed fact of this island having been poured forth by an eruption from Ischia. Far more probably, Prochyta was formed independently by submarine eruptions, as the volcanic islands near Santorin have been produced in more recent times.

"So fierce were the eruptions from Pithecusa, that several Greek colonies which attempted to settle on this island were compelled to leave it. About 380 years before the Christian era, colonists under King Hiero of Syracuse, who had built a fortress on Pithecusa, were driven away by an eruption. Nor were eruptions the sole cause of danger. Poisonous vapours, such as are emitted by volcanic craters after eruption, appear to have exhaled, at times, from extensive tracts on Pithecusa, and thus to have rendered the island uninhabitable.

"Still nearer to Vesuvius lay the celebrated Lake Avernus. The name Avernus is said to be a corruption of the Greek word *Aornos*, signifying 'without birds,' the poisonous exhalations from the waters of the lake destroying all birds which attempted to fly over its surface. Doubt has been thrown on the destructive properties assigned by the ancients to the vapours ascending from Avernus. The lake is now a healthy and agreeable neighbourhood, frequented, says Humboldt, by many kinds of birds, which suffer no injury whatever even when they skim the very surface of the water. Yet there can be little doubt that Avernus hides the outlet of an extinct volcano; and long after this volcano had become inactive, the lake which concealed its site 'may have deserved the appellation of "atri janua Ditis," emitting, perhaps, gases as destructive of animal life as those suffocating vapours given out by Lake Quilotoa, in Quito, in 1797, by which whole herds of cattle were killed on its shores, or as those deleterious emanations which annihilated all the cattle in the island of Lancerote, one of the Canaries, in 1730.'

"While Ischia was in full activity, not only was Vesuvius quiescent, but even Etna seemed to be gradually expiring, so that Seneca ranks this volcano among the number of nearly extinguished craters. At a later epoch, Ælian asserted that the mountain itself was sinking, so that seamen lost sight of the summit at a less distance across the seas than of old. Yet within the last two hundred years there have been eruptions from Etna rivalling, if not surpassing, in intensity the convulsions recorded by ancient historians.

"I shall not here attempt to show that Vesuvius and Etna belong to the same volcanic system, though there is reason not only for supposing this to be the case, but for the belief that all the subterranean regions whose effects have been shown from time to time over the district extending from the Canaries and Azores, across the whole of the Mediterranean, and into Syria itself, belong to but one great centre of internal action. But it is quite certain that Ischia and Vesuvius are outlets from a single source.

"While Vesuvius was dormant, resigning for awhile its pretensions to be the principal vent of the great Neapolitan volcanic system, Ischia, we have seen, was rent by frequent convulsions. But the time was approaching when Vesuvius was to resume its natural functions, and with all the more energy that they had been for awhile suspended.

"In the year 63 (after Christ) there occurred a violent convulsion of the earth around Vesuvius, during which much injury was done to neighbouring cities, and many lives were lost. From this period shocks of earthquake were felt from time to time for sixteen years. These grew gradually more and more violent, until it began to be evident that the volcanic fires were about to return to their main vent. The obstruction which had so long impeded the exit of the confined matter was not, however, readily removed, and it was only in August of the year 79, after numerous and violent internal throes, that the superincumbent mass was at length hurled forth. Rocks and cinders, lava, sand, and scoriæ,

were propelled from the crater, and spread many miles on every side of Vesuvius.

"In this great eruption, Vesuvius poured forth lapilli, sand, cinders, and fragments of old lava, but no new lava flowed from the crater. Nor does it appear that any lava-stream was ejected during the six eruptions which took place during the following ten centuries. In the year 1036, for the first time, Vesuvius was observed to pour forth a stream of molten lava. Thirteen years later, another eruption took place; then ninety years passed without disturbance, and after that a long pause of 168 years. During this interval, however, the volcanic system, of which Vesuvius is the main but not the only vent, had been disturbed twice. For it is related that in 1198 the Solfatara Lake crater was in eruption; and in 1302 Ischia, dormant for at least 1,400 years, showed signs of new activity. For more than a year earthquakes had convulsed this island from time to time, and at length the disturbed region was relieved by the outburst of a lava stream from a new vent on the south-east of Ischia. The lava stream flowed right down to the sea, a distance of two miles. For two months, this dreadful outburst continued to rage; many houses were destroyed; and although the inhabitants of Ischia were not completely expelled, as happened of old with the Greek colonists, yet a partial emigration took place.

"The next eruption of Vesuvius occurred in 1306; and then three centuries and a quarter passed during which only one eruption, and that an unimportant one (in 1500), took place. 'It was remarked,' says Sir Charles Lyell, 'that throughout this long interval of rest, Etna was in a state of unusual activity, so as to lend countenance to the idea that the great Sicilian volcano may sometimes serve as a channel of discharge to elastic fluids and lava that would otherwise rise to the vents in Campania.'

"Nor was the abnormal activity of Etna the only sign that the quiescence of Vesuvius was not to be looked upon as any evidence of declining energy in the volcanic system. In 1538 a new mountain was suddenly thrown up in the Phlegræan Fields—a district including within its bounds Pozzuoli, Lake Avernus, and the Solfatara. The new mountain was thrown up near the shores of the Bay of Baiæ. It is 440 feet above the level of the bay, and its base is about a mile and a half in circumference. The depth of the crater is 421 feet, so that its bottom is only six yards above the level of the bay. The spot on which the mountain was thrown up was formerly occupied by the Lucrine Lake; but the outburst filled up the greater part of the lake, leaving only a small and shallow pool.

"The accounts which have reached us of the formation of this new mountain are not without interest. Falconi, who wrote in 1538, mentions that several earthquakes took place during the two years preceding the outburst, and above twenty shocks on the day and night before the eruption. 'The eruption began on September 29, 1538. It was on a Sunday, about one o'clock in the night, when flames of fire were seen between the hot-baths and Tripergola. In a short time the fire increased to such a degree that it burst open the earth in this place, and threw up a quantity of ashes and pumice-stones, mixed with water, which covered the whole country. The next morning the poor inhabitants of Pozzuoli quitted their habitations in terror, covered with the muddy and black shower, which continued the whole day in that country—flying from death, but with death painted in their countenances. Some with their children in their arms, some with sacks full of their goods; others leading an ass, loaded with their frightened family, towards Naples. . . . The sea had retired on the side of Baiæ, abandoning a considerable tract; and the shore appeared almost entirely dry, from the quantity of ashes and broken pumice-stones thrown up by the eruption.'

"And now, for nearly a century, the whole district continued in repose. Nearly five centuries had passed since there had been any violent eruption of Vesuvius itself; and the crater seemed gradually assuming the condition of an extinct volcano. The interior of the crater is described by Bracini, who visited Vesuvius shortly before the eruption of 1631, in terms that would have fairly represented its condition before the eruption of 79:—'The crater was five miles in circumference, and about a thousand paces deep; its sides were covered with brushwood, and at the bottom there was a plain on which cattle grazed. In the woody parts, wild boars frequently harboured. In one part of the plain, covered with ashes, were three small pools, one filled with hot and bitter water, another salter than the sea, and a third hot, but tasteless.' But in December, 1631, the mountain blew away the covering of rock and cinders which supported these woods and pastures. Seven streams of lava poured from the crater, causing a fearful destruction of life and property. Resina, built over the site of Herculaneum, was entirely consumed by a raging lava-stream. Heavy showers of rain, generated by the steam evolved during the eruption, caused in their turn an amount of destruction scarcely less important than that resulting from the lava-streams; for, falling upon the cone and sweeping thence large masses of ashes and volcanic dust, these showers produced destructive streams of mud, consistent enough to merit the name of 'aqueous lava' commonly assigned to it.

"An interval of thirty-five years passed before the next eruption, but since 1666 there has been a continual series of eruptions, so that the mountain has scarcely ever been at rest for more than ten years together. Occasionally there have been two eruptions within a few months; and it is well worthy of remark that during the three centuries which have elapsed since the formation of Monte Nuovo there has been no volcanic disturbance in any part of the Neapolitan volcanic district save in Vesuvius alone. Of old, as Brieslak well remarks, there had been irregular disturbances in some part of the Bay of Naples once in every two hundred years—the eruption of Solfatara in the twelfth century, that of Ischia in the fourteenth, and that of Monte Nuovo in the sixteenth; but 'the eighteenth has formed an exception to the rule.' It seems clear that the constant series of eruptions from Vesuvius during the past two hundred years has sufficed to relieve the volcanic district of which Vesuvius is the principal vent."

So I wrote a few years ago, but the great earthquake from Ischia shows that the old state of things has not so completely passed away as had been supposed.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XIII.

Traditions of transformation of men into beasts are not confined to the Old World. In Dr. Rink's "Tales of the Eskimo" there are numerous stories both of men and women who have assumed animal form at will, as also incidental references to the belief in stories such as that telling how an Eskimo got inside a walrus skin, so that he might lead the life of that creature. And among the Red Races, that rough analogy which led to the animal being credited with life and consciousness akin to the human, still expresses

itself in thought and act. If even now it is matter of popular belief in the wilds of Norway that Finns and Lapps, who from remote times have passed as skilful witches and wizards, can at pleasure assume the shape of bears, the common saying, according to Dr. Dasent, about an unusually daring and savage beast being, "that can be no Christian bear," we may not be surprised that lower races still ascribe power of interchange to man and brute. The werewolf superstition is extant among the North-Western Indians, but free from those diabolical features which characterised it in mediæval times among ourselves. It takes its place in barbaric myth generally, and although it may have repellant or cruel elements, it was never blended with belief in the demoniacal. The Ahts say that men go into the mountains to seek their manitou (that is, the personal deity, generally the first animal seen by the native in the dream produced by his fasting on reaching manhood), and, mixing with wolves, are after a time changed into these creatures. Although the illustration bears more upon what has to be said concerning the barbaric belief in animal-ancestors, it has some reference to the matter in hand to cite the custom among the Tonkanays, a wild and unruly tribe in Texas, of celebrating their origin by a grand annual dance. One of them, naked as he was born, is buried in the earth, then the others, clothed in wolf-skins, walk over him, sniff around him, howl in wolfish style, and then dig him up with their nails. The leading wolf solemnly places a bow and arrow in his hands, and, to his inquiry as to what he must do for a living, advises him "to do as the wolves do—rob, kill, and rove from place to place, never cultivating the soil." Dr. Brinton, in quoting the above from Schoolcraft, refers to a similar custom among the ancient dwellers on Mount Soracte.

As in past times among ourselves, so in times present among races such as the foregoing, their wizards and shamans are believed to have power to turn themselves as they choose into beasts, birds, or reptiles. By whatever name these professional impostors are known, whether as medicine-men, or, as in Cherokee, by the high-sounding title of "possessors of the divine fire," they have traded, and wherever credulity or darkest ignorance abide, still trade, on the fears and fancies of their fellows by disguising themselves in voice and gait and covering as the animal which they pretend to be. Among races believing in transformation such tricks have free course, and the more dexterous the sorcerer who could play bear's antics in a bear's skin proved himself in throwing off the disguise and appearing suddenly as a man, the greater his success, and he more firmly grounded the belief.

The whole subject, although presented here only in the barest outline, would not be fitly dismissed without some reference to the survival of the primitive belief in men-animals in the world-wide stories known as Beast-fables, in which animals act and talk like human beings. When to us all Nature was wonderland, and among our playfellows were the four-footed, the birds, and the fishes; when in fireside tale and rhyme they spoke our language and lived that free life which we then shared and can never share again, the feeling of kinship to which the old fables gave expression may have checked many a wanton act, and, if we learned it not fully then, at least have taken the lesson to heart since,

> Never to blend our pleasure or our pride
> With sorrow of the meanest thing that lives.

And then those "Fables" of Æsop, even with the tedious drawback of the "moral," as powder beneath the jam, did they not lighten for us in school-days the dark passages through our Valpy (for the omniscient Dr. William Smith was not then the tyro's dread), and again give us communion with the fowl of the air and the beast of the field? Now, our mature thought may interest itself in following the beast-myths to the source whence Babrius and Phædrus, knowing not its springhead and antiquity, drew their vivid presentments of the living world, and find in the storied East the wellspring that fed the imagination of youngsters thousands of years ago. With some authorities the Egyptians have the credit of first inventing the beast-fable, but among them, as among every other advanced race, such stories are the remains of an earlier deposit; relics of a primitive philosophy, in which wisdom, and skill, and cunning are no monopoly of man's. The fondness of the negro races, whose traditions are not limited to South and Central Africa, for such fables is well known, as witness the tales of which "Uncle Remus" is a type, and it is strikingly illustrated in the history of the Vai tribe, who having, partly through contact with whites, elaborated a system of writing, made the beast-fable their earliest essay in composition.*

In former papers, the evidence in support of the common ancestry of the languages spoken by the leading peoples in Europe, and by such important historical races in Asia as the Hindu and the Persian, has been summarised. That evidence is likewise conclusive, not only as to the origin of the myths on which the great Indo-European epics are founded, but also as to the possession by the several clans of a common stock of folk-lore and folk-tale, in which, of course, the beast-fable is included, these being the relics in didactic or humorous guise of that serious philosophy concerning the life of man and beast amongst the barbaric ancestors of the Indo-Europeans, upon which stress enough has been laid.

Even if the common origin could be disproved, the evidence would merely be shifted from local to general foundations, because the uniform attitude of mind before the same phenomena would be proven; but the resemblances are too minute in detail to be explained by a theory of independent creation of the tales where now we find them. The likenesses are many; the unlikenesses are few, being the result of local colouring, historical fact blended with the fiction, popular belief, and superstition, all affected by the skill of the professional story-teller. As in the numerous variants of the familiar Cinderella, Beauty and the Beast, Punchkin, and the like, the same fairy prince or princess, the same wicked magician and clever, versatile Boots peep through, disclosing the near relationship of Hindu nursery tales to the folk-tales of Norway and the Highlands, of Iceland and Ceylon, of Persia and Serbia, of Russia and the lands washed by the Mediterranean. In the venerable collection of "Buddhist Birth Stories," now in course of translation by Dr. Rhys Davids,† and to which he has prefaced an interesting introduction on the source and migration of folk-tales, we are face to face with many a fable familiar to us in the "Æsop" of our school-days. There is the story of the Ass in the Lion's Skin, not in which, as Æsop has it, the beast dressed himself, but which the hawker put on him to frighten the thieves who would steal his goods. Left one day to browse in a field whilst his master refreshed himself at an inn, some watchmen saw him, and, raising hue and cry, brought out the villagers, armed with their rude implements. The ass, fearing death,

* Cf. Mahaffy's "Prolegomena to Ancient History," p. 392.

† Vol. I. Trübner & Co. See also, for some valuable illustrations from early English and other sources, an article by Rev. Dr. Morris, in "Contemp. Rev.," May, 1881.

made a noise like an ass, and was killed. Long might he, adds the ancient moral,

> Clad in a lion's skin
> Have fed on the barley green;
> But he brayed!
> And that moment he came to ruin.

The variants of this old fable are found in mediæval, in French, German, Indian, and Turkish folk-lore, as are also those of the tortoise who lost his life through "much speaking." Desiring to emigrate, two ducks agreed to carry him, he seizing hold of a stick which they held between their beaks. As they passed over a village, the people shouted and jeered, whereupon the irate tortoise retorted, "What business is it of yours?" and, of course, thereby let go the stick and, falling down, split in two. Therefore

> Speak wise words not out of season;
> You see how, by talking overmuch,
> The tortoise fell."

In Æsop, the tortoise asks an eagle to teach him to fly; in Chinese folk-lore he is carried by geese.

Jacob Grimm's researches concerning the famous mediæval fable of "Reynard the Fox," revealed the ancient and scattered materials out of which that wonderful satire was woven, and there is no feature of the story which reappears more often in Eastern and Western folk-lore than that cunning of the animal which has been for the lampooner and the satirist the type of self-seeking monk and ecclesiastic. When Chanticleer proudly takes an airing with his family, he meets master Reynard, who tells him he has become a "religious," and shows him his beads, and his missal, and his hair shirt, adding in a voice "that was childlike and bland," that he had vowed never to eat flesh. Then he went off singing his Credo, and slunk behind a hawthorn. Chanticleer, thus thrown off his guard, continues his airing, and the astute hypocrite, darting from his ambush, seizes the plump hen Coppel. So in Indian folk-tale, a wolf living near the Ganges is cut off from food by the surrounding water. He decides to keep holy day, and the god Sakka, knowing his lupine weakness, resolves to have some fun with him, and turns himself into a wild goat. "Aha!" says the wolf, "I'll keep the fast another day," and springing up he tried to seize the goat, who skipped about so that he couldn't be taken. So Lupus gives it up, and says as his solatium: "After all, I've not broken my vow."

The Chinese have a story of a tiger who desired to eat a fox, but the latter claimed exemption as being superior to the other animals, adding that if the tiger doubted his word, he could easily judge for himself. So the two set forth, and, of course, every animal fled at sight of the tiger, who, too stupid to see how he had been gulled, conceived high respect for the fox, and spared his life.

Sometimes the tables are turned. Chanticleer gets his head out of Reynard's mouth by making him answer the farmer, and in the valuable collection of Hottentot tales which the late Dr. Bleek, with some warrant, called "Reynard in South Africa," the cock makes the jackal say his prayers, and flies off while the outwitted beast folds his hands and shuts his eyes.

But I must forbear quoting further. Enough if it is made clearer to the reader that the Beast-fable is the lineal descendant of barbaric conceptions of a life shared in common by man and brute, and another link thus added to the lengthening chain of the continuity of human history.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(*Continued from page 70.*)

In my last I described the Bedford level experiment in which use was made of a telescope *t* at A, (Fig. 3 *bis*) and of a disc *b* at B three miles off, to determine the deviation of the line of sight from *t* to *c* (another disc at C) six miles off, from the disc *b*,—*t*, *b*, and *c* being all at exactly the same height above the water surface A B C. The result was, to show *b* several times its own diameter above *c*, a simple and decisive proof that the points *t*, *b*, *c*, were not in a straight line,—as of course they would have been if the water surface were plane and therefore A B C a straight line.

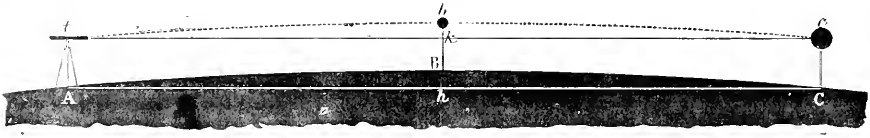


Fig. 3, *bis*.

To direct the telescope *t* to *c* it had to be slightly depressed, at least if *c* were brought exactly to the centre of the field of view. But it seems that although the telescope was apparently level—indeed one account says that it was carefully levelled—the distant disc *c* appeared to be in the centre of the field, absolutely coincident with the intersection of two cross-hairs marking the centre of the field. On the strength of this observation the loser claimed that the stakes should be handed to him. The claim was natural enough, and no doubt honestly made. Doubtless, also, the loser was convinced then and he may even be convinced still that wrong was done to him in the rejection of his claim. Be this as it may, it was probably unfortunate for him that he was thus led astray, as there is every reason to believe that his stake would have been returned to him by the winner but for the wild and angry ways into which this mistaken notion caused the loser to indulge.

Now let us inquire where his mistake lay. We shall thus be led to a proof of the earth's rotundity which though not so simple and striking as the one described at page 69, is really as convincing. It can readily be tested at the seaside by any one of ingenious and handy turn.

In the plan illustrated in Fig. 3, the disc *b* may be regarded as part of the apparatus employed to measure the depression of *c*. Of course *b* is itself depressed below the true horizon plane through *t*, but *c* is depressed four times as much, and therefore seen below the disc *b* in the telescopic field. In the other test, the disc at *b* is not used to help the observer. Let us see what remains to show the earth's rotundity.

Consider the geometry of the matter. It is simple enough:—Let A, B, C, &c., Fig. 5 represent the same points as the same letters in Fig. 3. Draw $t\,b'\,c'$ square to t A producing B b and C c to meet $t\,c'$ in b' and c' respectively. Also join $t\,b$, and produce to meet C c in c''. Then we know that the angle $c\,t\,c'$ is equal to the angle in the alternate segment of the large circle of which $t\,b\,c$ is a part,

The loser of the wager asserts that the signal c (not the central point c) was on the line $h\,h'$, though admitting that b was above c. Thus if the centre of c was on $h\,h'$ the centre of b was above $h\,h'$: and if the centre of b was on $h\,h'$ the centre of c was below $h\,h'$. Either result would suffice to show that the explanation based on the straightness of the line $t\,b\,c$ was certainly erroneous. *Both* b and c

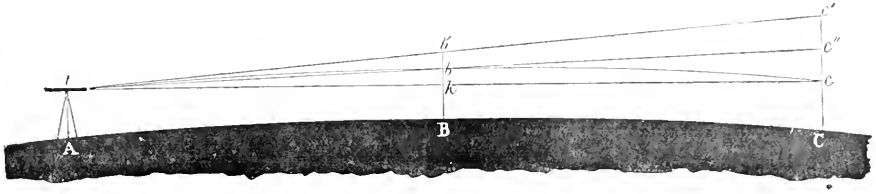


Fig. 5.

were not on $h\,h'$, as they must both have been had the straight line from t to c been in the real horizon.

We *know* then already that either the observation on the strength of which c was supposed to be on $h\,h'$ was but rough, or else the instrumental adjustments were imperfect, the telescope not truly levelled, or $h\,h'$ not truly across the centre of the field.

and therefore to twice the angle $b\,t\,c$ on the arc $b\,c$ (which is half of $t\,b\,c$). Hence, the lines B b', C c' being approximately parallel, we see that

$$b\,b' = k\,b = 6 \text{ ft. approximately;}$$
$$c\,c'' = c'c'' = b'k = 12 \text{ ft. approximately;}$$
and
$$c\,c' = 2c\,c'' = 24 \text{ ft. approximately.}$$

Now when the telescope at t is truly levelled it is so directed that its optical axis is in the straight line $t\,b'\,c'$,—so that as the disc c lies in the direction $t\,c$, while b lies in the direction $t\,b\,c''$, we ought if the centre of the field were exactly marked to see b below that centre by a certain small distance and c twice as far below that centre. Regarding these as small dots, we should see what is shown in Fig. 6 where a marks the intersection of the cross lines, b the centre of disc b, and c the centre of the remoter disc c.

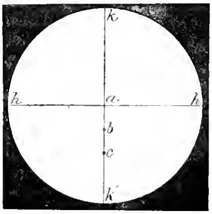


Fig. 6.

All this is nearly as obvious as what we found in the other test, only not quite so simple. If our telescope were perfectly levelled, the horizontal cross hair $h\,h'$ absolutely central, b removed, and c were found to be exactly on $h\,h'$, then—why then—Well, if the sky were to fall we should catch larks. The earth-flatteners should hardly expect astronomers even then to admit that the earth is flat, simply because there are a hundred other absolutely overwhelming proofs that the earth is a globe. It would be difficult to explain such an anomaly as would thus be indicated. Either it would appear that the water surface A B C unlike the ocean surface, or any other liquid surface, was absolutely plane, perhaps through some abnormal local attractions—or else it would appear that some abnormal refractive action of the atmosphere had raised c up to the true horizon of t. Not one jot would or *could* the faith of astronomers in the rotundity of the earth, proved a hundred ways, waver before such evidence. But, of course, no such evidence has ever been obtained.

But let us see how great the distance $a\,c$ in Fig. 6 should have been, supposing the adjustments all *perfect*. Suppose the magnifying power of the telescope to have been 12, that being about the utmost magnifying power likely to be used in a levelling experiment of the kind—for long telescopes are never used with exact adjustments to bring the optical axis level. Then we have $c\,c'$ (Fig. 5)=24 feet. But atmospheric refraction practically reduces $c\,c$ by about a fourth leaving 18 ft. only. Thus the angle $c\,t\,c'$ as observed with the naked eye (*i.e.*, as distinguished from the geometrical angle $c\,t\,c'$) is the angle subtended by 18 ft. at a distance of six miles or of eighteen times 1760 ft. This is the angle subtended by 1 ft. at a distance of 1760 ft., or by 1 inch at a distance of 1760 inches, or by the hundredth of an inch at a distance of nearly 18 inches. As the telescopic magnifying power increases this angle twelvefold, we have the angle actually observed with the telescope equal to that subtended by the hundredth of an inch at a distance of 1½ in. It is exactly one-tenth of the angle B O A in Fig. 7, and is fairly represented by the dark line B O pointed at end O.

Fig. 7.

Is it likely that an unpractised observer (all the observers in the Bedford experiment were unpractised) would detect the depression of the distant signal c below $h\,h'$ by this small angle—the signal not being a point but a disc—even if the cross hair $h\,h'$ had been precisely adjusted to correspond with the real horizon? But it is exceedingly unlikely that $h\,h'$ was properly adjusted. If not, and there are few nicer adjustments in practical surveying, it is certain that none of the observers employed could have even detected, far less have corrected, the error.

This particular test, then, under the conditions existing, was practically worthless,—the appearance of c below b was a hundred times better as a test, and indeed of itself proved (if the loser's statement about c being on the cross hairs can be trusted) that the levelling of the telescope and the adjustment of the horizontal cross hair were inexact.

But there is a pretty way of testing the depression of the water horizon due to terrestrial rotundity, which requires no telescope, and only a little care in execution. Parallax used the method, in a purposely inexact way to show the earth to be flat.

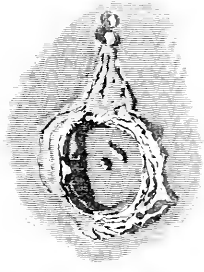
This method will be considered in our next.

(To be continued.)

THE MOON IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

When the Moon is nine or ten days old, the Bay of Rainbows (P in our map) presents a perfectly charming spectacle to the observer. This great, dark, semicircular area appears absolutely level in the instrument we are using, but is surrounded by a mass of stupendous cliffs. It measures, from Cape La Place (134) to Cape Heraclides (135), nearly 135 miles. Heraclides rises some 4,000 feet above the level of the bay, but is as a mere hillock compared with some of the neighbouring highlands. As we travel in an easterly direction we arrive at Sharp (139), 15,000 feet in height, and some of the peaks in this chain probably attain an altitude approaching to 20,000 feet. Nearly due south of Cape La Place lie two little, but exceedingly deep craters—the Eastern one of which, Helicon, is marked 129 in the map. And now we arrive at a region covered with systems of light streaks, akin to those described on p. 56 as emanating from Tycho. Euler (125), a fine ring plain, 19 miles in diameter, with a central peak, is the centre of one of these systems of rays. Tobias Mayer (117), 22 miles across, is an interesting object under suitable illumination. Of all the formations, however, in this region of the Lunar surface, there is nothing to compare with that superb one, Copernicus (112),

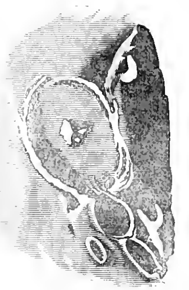


Copernicus. Moon's Age, 10·27 days.

our sketch of which above was taken with a power of 160, when the moon's age was 10·27 days. This magnificent ring-plain measures 56 miles across. There are, altogether, eight peaks rising from the interior—three bright ones, and four less so. With the instrument employed, however, and under the conditions of illumination then obtaining, two only of these were, as will be seen, visible at the epoch of our drawing. The terraced character of the wall is conspicuous enough, even in a 3-in. telescope, as is the disturbed and complicated character of the region immediately surrounding it. Two deep craters south of Copernicus, approximating in appearance to the figure 8, will at once strike the eye. So also will a conspicuous peak on the western wall, which is between 11,000 and 12,000 ft. high. The somewhat angular character of the contour of the wall is well seen from the shadows cast towards the east. Other features will strike the attentive observer. At full moon, Copernicus is seen to be the centre of a system of light streaks, uniting with similar ones from other formations, to which we shall hereafter refer. It is worthy of note that the streaks extending in a westerly direction from Copernicus are the most numerous; though those which lie towards the north are individually more conspicuous. There is an enormous number of tiny craters between Copernicus and Eratosthenes (110); but even the largest of these require favourable illumination and conditions, to be seen in our instrument. Reinhold (114), 31 miles across, will repay scrutiny while the telescope is turned on this part of the moon's visible disc. Euclid (221), and Landsberg (222), furnish examples of craters surrounded by a kind of nimbus or light ring. This, as will be seen on examination, differs in appearance from the streaks emanating from Tycho, Copernicus, Kepler, and Aristarchus. Kepler (144), by the way, may be here referred to as a crater, close upon 22 miles across, the centre of a great system of light streaks, uniting with those from Copernicus. Close to Euclid lie the Riphæan Mountains (220). Under oblique illumination they strongly suggest an exaggerated, or caricatured, bas-relief of a llama or giraffe. One of the deepest craters in the Sea of Clouds is Bullialdus (213), to which a light streak extends (as mentioned on page 56) from Tycho (180). This is 38½ miles across, with finely-terraced walls of considerable breadth, and a fine central mountain 3,000 feet high. The considerable crater or ring-plain, breaking into the southern wall, too, will at once strike the eye, while a very similar one (but detached from Bullialdus proper) will be noted to the south of this again. Campanus (226), a ring 30½ miles across, in this neighbourhood, is chiefly remarkable for the darkness of its interior. Hainzel (237) is a kind of pear-shaped ring-plain, 55 miles in its longest diameter, with high and precipitous walls rising some 11,600 ft. in places. The wall of Capuanus (238), too, will repay examination under suitable illumination. Capuanus is one of the comparatively few craters that remain conspicuous and identifiable when the Moon is full. We are now in the neighbourhood of the Sea of Moisture (T in our map). The student may begin his examination of this region with the large bay in this "sea," Hippalus (225). The chief interest, however, attaching to this locality resides in the wonderful system of "rills," or narrow and tortuous clefts, existing to the west of Hippalus. The majority of these require a large instrument for their detection, but one or two of them are within the reach of a three-inch telescope when the Moon is between nine and ten days old. The formation of Vitello (229) seems to afford an illustration of the vulgar phrase, "a wheel within a wheel," inasmuch as the outer ring-plain encloses another one, from the interior of which rises a mountain. 1,600 ft. or 1,700 ft. high. With the examination of Gassendi (232), on the northern boundary of the Sea of Moisture, we shall conclude another night's work.

Our sketch of this fine and interesting formation was made with a power of 160, the moon being 11·24 days old, and Gassendi very nearly on the terminator. The diameter of this great walled plain is fifty-five miles. The height of its surrounding cliffs varies greatly; in places they rise to an altitude of some 10,000 feet, while towards the south, as will be seen in the drawing we give, they diminish to a twentieth part of that height. It is worthy of remark that Mädler asserts that the floor of Gassendi is in its northern part quite 2,000 feet above the level of the almost adjoining Sea of Moisture. It will be observed how the northern part of the wall has been destroyed by the subse-

quent eruption in which the great spoon-shaped ring plain shown was formed. At the epoch of our sketch, the three central mountain masses, rising from the principal plain, were conspicuously shown. It will be seen that the westernmost of these is the largest and highest, the tips of the others only peeping, as it were, out of its shadow. This is a formation which may be advantageously studied continuously during the eleventh and twelfth days of the moon's age, as it exhibits so many complicated features; and it is most instructive to the beginner to note how these come into view, and alter in aspect with advancing sunlight. Moreover, the student should observe it in different states of the moon's libration.* The changes produced in the aspect of formations in the neighbourhood of the moon's limb from this cause are most striking and remarkable.



Gassendi. Moon's age, 11·24 days.

(*To be continued.*)

WEATHER FORECASTS,

AND HOW TO MAKE THEM.

By John Browning, F.R.A.S.

INTRODUCTION.

NEARLY all the readers of Knowledge, I imagine, turn to the portion of their daily newspaper which contains the forecast of the weather issued by the Meteorological Committee of the Board of Trade at 8.30 p.m. on the previous day, to see what weather is predicted. Very various are the opinions as to the accuracy of these predictions, some declaring them to be nearly always right, while others say they are nearly always wrong. My own opinion, after noting them carefully for years, is, that where the weather is alike over large areas, the forecasts are in the main correct; and when the weather is partial, observations taken at a number of points in either of the areas would show the forecast for that area to be fairly correct. But with partial weather, which we so often experience in England, many persons will find the prediction proves inaccurate. The only remedy for this is to forecast the weather for each district for ourselves.

After the experience of several months, I am satisfied that this may be done with considerable accuracy. I was first induced to give my attention to this subject from my desire to know when I might undertake long journeys on a tricycle with a fair prospect of fine weather. But a very little consideration will show that the matter is one of national importance. There is enough good weather probably in the worst seasons to get in all standing crops safely if agriculturists only knew when to expect it and could take advantage of it. What is greatly required, is accurate predictions of the probability of rain. The weather forecasts of the Board of Trade are nearly always correct as regards the direction and force of the wind. Now to foretell rain it is well-known that the barometer is useful, but it should not be relied on solely, as there are two instruments which give indications that are more serviceable; these are the Rain-band Spectroscope and the Weather Compass.

THE RAIN-BAND SPECTROSCOPE.

To refer first to the rain-band spectroscope. For years it was known that there were many lines in the solar spectrum which could not be identified with the lines given by any of the metals. It was noticed that these lines were more numerous about sunrise and sunset. Jannssen, the French astronomer, showed that these lines were due to moisture—that is, the vapour of water being present in our atmosphere. The increase in their number and intensity about sunrise and sunset is due to the fact that the sun's rays at those times pass through a large amount of our atmosphere.

The proof that Jannssen gave of the source of these lines, though exceedingly simple, was convincing. He placed a bright light of burning coal-gas, or oil, at one end of an iron tube thirty feet long, and a spectroscope at the other end. The spectrum of the bright flame seen in this way was, of course, a continuous spectrum without any lines. Then he closed both ends of the tube with plates of glass, and filled the tube with transparent steam. The spectrum of the light seen through the steam contained a great number of fine lines which corresponded with those seen in the solar spectrum near sunset, and were most numerous near the red end of the spectrum.

Professor Piazzi Smyth first observed that these lines were more numerous in the spectrum before a fall of rain, and proposed to use them for the purpose of predicting rain. But he used in his experiments a powerful and expensive instrument—difficult to use and too expensive for general adoption. Mr. J. Rand-Capron has recently found that equally good results may be obtained by using a spectroscope, which can be bought for as many shillings as the original instrument cost pounds.

In his small pamphlet, "A Plea for the Rain-band," reprinted from the *Meteorological Magazine*, Mr. Rand-Capron has described his method of using the smaller instrument.

The original papers, both of Professor Smyth and Mr. Rand Capron, were, of course, addressed to the scientists. The editor of Knowlege having kindly asked me for some papers on this subject, I shall try my utmost to make my instructions for using the instrument as clear as possible.

(*To be continued.*)

THE FISHERIES EXHIBITION.

By John Ernest Ady.

IV.

IN our last contribution we proposed to take a glance at the sponges which adorn some of the cases in the Exhibition, and to show how they came to occupy their present place in the system of zoology. At the outset we may state that their true systematic position has been only recently established, through technical methods of research

* For an explanation of lunar libration, see "The Moon," by the editor of Knowledge (Longman & Co.), pp. 118, *et seq.*

into their minute structure and developmental history, without which their real nature could never have been determined. This, then, affords an explanation of how it was that the older naturalists looked upon them as plants, and subsequently regarded them as composite animals of a primitive type.

The sponges are amongst the most useful and beautiful objects in the Exhibition. Their utility is obvious to everyone in the civilised world, and particularly to a large community of individuals who depend for their living entirely upon the sponge fisheries.

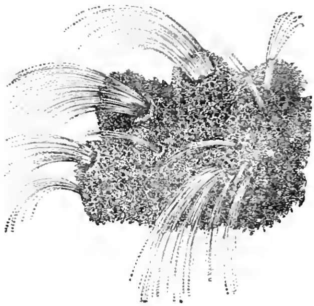


Fig. 8.—Commercial Sponge, showing outgoing currents of water.

In modern times the chief sponge fisheries are confined to the regions around the Bahamas and in the Mediterranean Sea, especially in the Grecian Archipelago, and the respective products of both localities are well represented in the foreign gallery of the Exhibition buildings which runs parallel with the aquarium.

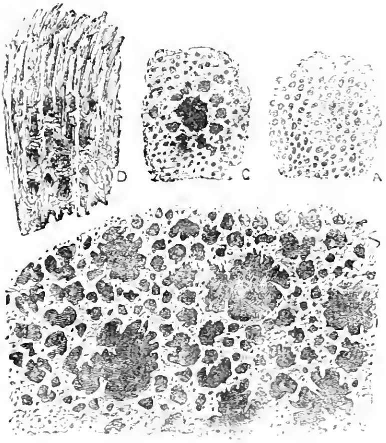


Fig. 9.—Outer surface of different kinds of sponge (natural size). A, cup-shaped variety; B, honeycomb sponge; C, toilet-sponge; D, Bahamas sponge, partly in sections, showing projecting extremities and internal tubular character.

Let us confine our attention at present to the external forms presented by these sponges, and revert in future communications to their anatomical characteristics and affinities.

There are thousands of sponges which are of no commercial value, either from a strictly utilitarian or an æsthetic point of view. The useful sponges, known as the sponges of commerce, belong to one small group, the *Spongia*, of which Fig. 8 is an example; they are divided into two principal subdivisions: 1. The common sponges (*Spongia officinalis*) of large rounded or flat forms, soft tissue, convex beneath, and of coarse texture. 2. The fine sponges (*Spongia usitatissimum*) of concave or cup-like form and fine texture.

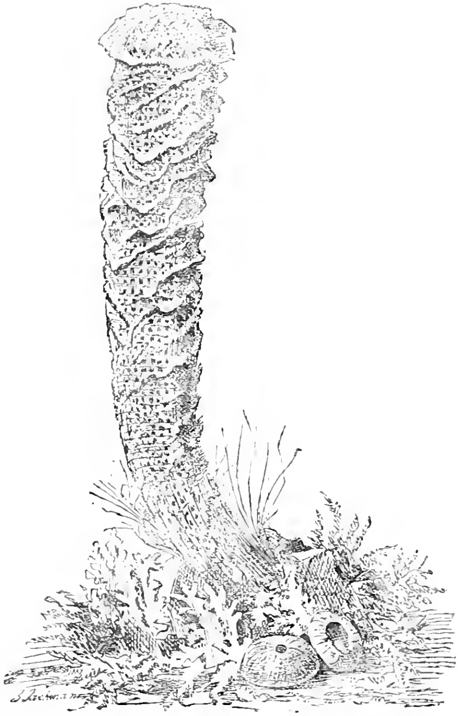


Fig. 10.—Siliceous skeleton of Venus's flower-basket, *Euplectella speciosa.*

It must be borne in mind that we are now speaking merely of the commercial article sponge, and not of the living animal of that name. The former is merely the skeleton of the latter, and consists, in the case of the sponges of commerce, entirely of a horny material called *keratose*, in the form of fine fibres matted together in such a way as to leave numerous large apertures and smaller pores throughout its substance. Fig. 9 shows these differences in texture of some of the principal sponges of commerce. As a rule, the sponges of the Mediterranean are finer than those of the West Indies; they are, therefore, of higher value for domestic purposes. The usefulness of the sponge must also largely depend on the purity of the fibres of its keratose skeleton and their elasticity, for upon these qualities do their absorbent powers depend.

But some of the sponges of commerce live under such adverse circumstances, amidst *débris* of all kinds, that particles of grit, &c., become inextricably woven into their

skeletons. Such varieties are used in America for stuffing cushions, bedding, and other upholstery work.

Yet other keratose sponges possess, in addition to their fibrous network, a number of siliceous spicules, which strengthen their skeletons, and also lie embedded in their fleshy substance (*e.g. Spongilla, Halichondria*); they are, therefore, of no special commercial value, although, as we shall show later on, they are of vast interest to the naturalist.

When the siliceous spicules predominate, and, finally, when they entirely take the place of the keratose, the sponges are known as siliceous; and amongst these are some of the most beautiful forms in nature. Fig. 10 is but a poor representation of the delicate beauty of one of these forms which occurs around the region of the Philippine Islands, and several specimens of which may be viewed in the Exhibition; more notably in Lady Brassey's *Sunbeam* collection, and in two beautiful groups encased in dome-shaped glasses at the end of the Natural History Galleries. We shall have occasion hereafter to give a brief description of the structure of these and other sponges.

We are indebted for these figures to the kindness of Messrs. Griffith & Farran, of St. Paul's Churchyard, from whose work, "The Commercial Products of the Sea," by P. L. Simmonds, they have been derived.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

II.—THE WHITE CARNATION.

Actinoloba dianthus (Blainville). *Actinia pentapetala* (Penn).

THIS is one of the largest of the British sea anemones, and also one of the handsomest. Large specimens—over a dozen of the purest white—may be seen in No. 10

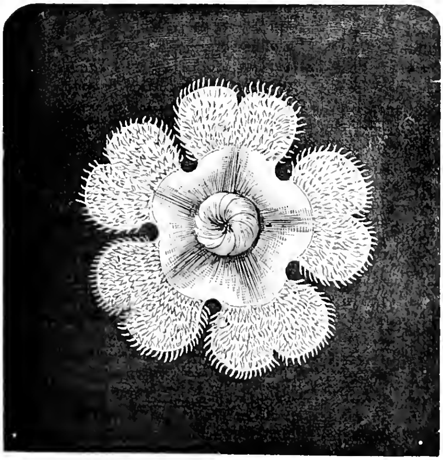


Fig. 1.—Disk, showing five principal lobes subdivided, mouth, &c.

tank, and still larger—4 or 5 inches across and 6 in height—in some of the other tanks; while there are young midgets not larger than a pea, with all intermediate sizes.

Fig. 1. *The disk, &c.*—In this species the principal lobes or petals vary in number from five to eight or nine, and each lobe is frequently subdivided and voluted, so that the entire disk, though truly circular in outline, will not expand into a plane surface. The tentacles are numerous in the adult near the mouth, and moderately long, but shorter near the margin; and the edges of each lobe and its sub-divisions are fringed with fine short tentacles that defy numeration. When the disk is much convoluted, as is usual in large specimens, it assumes a semi-globose form, and has a feathery surface. Hence the expressive name *plumosa*, given to this anemone by several writers. The mouth has a thick lip, divided into lobes, and is generally rufous or orange, whatever the general colour of the animal may be.

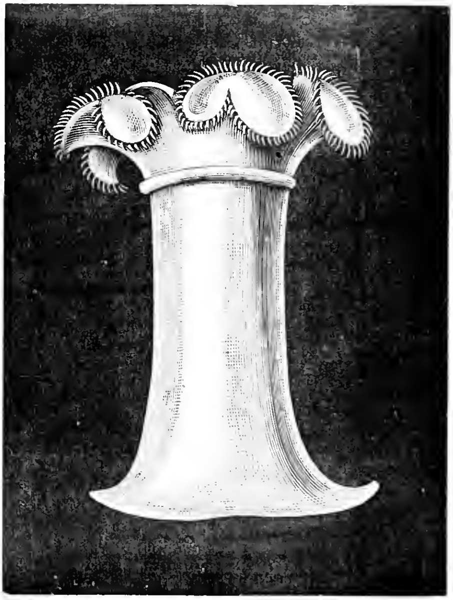


Fig. 2.—Column, edge of disk, &c.

Fig. 2. *The column, &c.*—A full-grown specimen in flower, as here shown, is a very beautiful object, and the greatest possible attraction to any aquarium. At the summit of the column is a thick, round rim, like a ring, and behind it the fosse. The base is always very much broader than the rest of the body. The white variety, which Figs. 1 and 2 illustrate, is not at all uncommon, and to it is universally conceded supremacy in beauty. Generally speaking, whatever the hue, it is uniform throughout in the same specimen. The commonest varieties are probably buff and cream colour, and then pale red. Amber, dark brown, and olive are comparatively rare varieties. The brown and olive examples have whitish tentacles, marked with an opaque bar. Several good examples of the olive dianthus with smoky-white disk, occur in the Exhibition.

The Button.—This anemone is exceptionally flat when closed, and to-day (July 31), in 10 tank, are good instances of the button form, both white and buff, and in different sizes. The outline of a large one is quite irregular, perhaps five inches across, thin as a card at the edges, and in the centre not more than the eighth of an inch in thickness.

Small shrimps in the tank are constantly approaching the disk, a dianthus, and dart away several inches, as if stung, on touching the tentacles. The instantaneous movement has quite the appearance of being the result of an electric shock.

Individuals of this species seem to vary in character. There appears to be a "quiet family," and a race much given to movement. Some of the more lively frequently change the contour of their figures, at one moment appearing tall and straight as a marble column, and the next constricted immediately below the margin (as if very fashionably laced), so that the fringed lobes droop over like a lily. This singular construction then gradually moves downwards, and, when half-way, gives the animal the form of an hour-glass. Gradually it descends almost to the base, but very soon moves up again, and the process is then reversed, until the lovely lily-like form is restored. This most interesting performance will sometimes continue for an hour together, the animal never retaining its ordinary shape for a minute at a time. The same individual will at other times be perfectly quiet for an entire day, the only perceptible motion being in the ever-varying fringe of down-like tentacles which encircle the disk.

Actinoloba is the name given by Blainville, 1834, and followed by Gosse, 1860. It is, or should be, derived from *ἀκτίν* a ray, and *λοβός* a lobe, and means an animal with lobed tentacles. The term *dianthus* is said to be thus named (*Δῖο* divine, *ἄνθος* flower), from its extreme beauty. Müller has named dianthus *Actiniarum pulcherrima*, the most beautiful of all anemones, and so far as this verdict relates to European species, it is admitted to be just. Writers vie with each other in its praise. The whole creature, one aptly declares, is exquisitely lovely, and can be compared only to the most graceful flower formed of rich white or amber feathers. Besides its extreme beauty of outline, the contrast in colour between this lovely creature and the medium in which it lives and moves is equally striking, and generally arrests the attention and elicits the admiration of the most careless observer.

The next paper will give a further account of dianthus with respect to locomotion and reproduction, how to obtain specimens and keep them in health, with a description of the gorgeous examples obtained by the United States exploring expedition.

A STEAMER GOES SAFELY PAST NIAGARA WHIRLPOOL.*

In the year 1846, a small steamer was built in the eddy just above the railway Suspension Bridge to run up to the Falls. She was very appropriately named—*The Maid of the Mist.* Her engine was rather weak, but she safely accomplished the trip. As, however, she took passengers aboard only from the Canada side, she did little more than pay expenses. In 1854 a larger, better boat, with a more powerful engine, the new *Maid of the Mist* was put on the route, and many thousands of persons made this most exciting and impressive tour under the Falls. The admiration which the visitor felt as he passed quietly along under the American Fall was changed into awe when he began to feel the mighty pulse of the great deep just below the tower; then swung around into the white foam directly in front of the Horse-shoe and saw the sky of waters falling toward him. And he seemed to be lifted on wings as he sailed swiftly down on the flying stream through a baptism of spray. To many persons there was a fascination about it that induced them to make the trip every time they had an opportunity to do so. Owing to some change in her appointments, which confined her to the Canadian shore for the reception of passengers, she became unprofitable. Her owner having decided to leave the place wished to sell her as she lay at her dock. This he could not do, but had an offer of something more than half of her cost, if he would deliver her at Niagara, opposite the Fort. This he decided to do, after consultation with Robinson, who had acted as her captain and pilot on her trips under the Falls. The boat required for her navigation an engineer, who also acted as a fireman, and a pilot. On her pleasure trips she had a clerk in addition to these. Mr. Robinson agreed to act as pilot for the fearful voyage, and the engineer, Mr. Jones, consented to go with him. A courageous machinist, Mr. McIntyre, volunteered to share the risk with them. They put her in complete trim, removing from deck and hold all superfluous articles. Notice was given of the time for starting, and a large number of people assembled to see the fearful plunge, no one expecting to see either boat or crew again, after they should leave the dock. This dock, as has been before stated, was just above the railway Suspension Bridge,* at the place where she was built, and where she was laid up in the winter; that, too, being the only place where she could lie without danger of being crushed by the ice. Twenty rods below this eddy the water plunges sharply down into the head of the crooked, tumultuous rapid which we have before noticed, as reaching from the bridge to the Whirlpool. At the Whirlpool the danger of being drawn under was most to be apprehended; in the Rapids of being turned over or knocked to pieces. From the Whirlpool to Lewiston is one wild, turbulent rush and whirl of water without a square foot of smooth surface in the whole distance.

About three o'clock in the afternoon of June 15, 1861, the engineer took his place in the hold, and, knowing that their flitting would be short at the longest, and might be only the preface to a swift destruction, set his steam-valve at the proper gauge, and awaited—not without anxiety—the tinkling signal that should start them on their flying voyage. McIntyre joined Robinson at the wheel on the upper-deck. Self-possessed, and with the calmness which results from undoubting courage and confidence, yet with the humility which recognises all possibilities, with downcast eyes and firm hands, Robinson took his place at the wheel and pulled the starting-bell. With a shriek from her whistle and a white puff from her escape-pipe to take leave, as it were, of the multitude gathered on the shores and on the bridge, the boat ran up the eddy a short distance, then swung around to the right, cleared the smooth water and shot like an arrow into the rapid under the bridge. She took the outside curve of the rapid, and when a third of the way down it a jet of water struck against her rudder, a column dashed up under her starboard side, heeled her over, carried away her smoke-stack, started her overhang on that side, threw Robinson flat on his back and thrust McIntrye against her starboard wheel-house with such a force as to break it through. Every eye was fixed; every tongue was silent, and every looker-on breathed freer as she emerged from the fearful baptism, shook her wounded sides, slid into the Whirlpool and for a moment rode again on an even keel. Robinson rose at once, seized the helm, set her to the right of the

* From "Niagara: Its History and Geology." By Geo. W. Holley.

* See the map in our last. We hope to give next week a view of the Whirlpool Rapids, from a photograph in the Editor's possession.

large pot in the pool, then turned her directly through the neck of it. Thence, after receiving another drenching from its combing waves, she dashed on without further accident to the quiet bosom of the river below Lewiston.

Thus was accomplished the most remarkable and perilous voyage ever made by men. To look at the boat and the navigation she was to undertake no one would have predicted for it any other than a fatal termination. The boat was seventy-two feet long with seventeen feet breadth of beam and eight feet depth of hold, and carried an engine of an hundred horse-power. In conversation with Robinson after the voyage, he stated that the greater part of it was like what he had always imagined must be the swift sailing of a large bird in a downward flight; that when the accident occurred the boat seemed to be struck from all directions at once; that she trembled like a fiddle-string and felt as if she would crumble away and drop into atoms; that both he and McIntyre were holding to the wheel with all their strength, but produced no more effect than if they had been two flies; that he had no fear of striking the rocks, for he knew that the strongest suction must be in the deepest channel, and that the boat must remain in that. Finding that McIntyre was somewhat bewildered by excitement or by his fall as he rolled up by his side but did not rise, he quietly put his foot on his breast to keep him from rolling round the deck, and thus finished the voyage.

The effect of this trip upon Robinson was decidedly marked. To it, as he lived but a few years afterward, his death was commonly attributed. But this was incorrect, since the disease which terminated his life was contracted at New Orleans at a later day. "He was," said Mrs. Robinson to the writer, "twenty years older when he came home that day than when he went out." He sank into his chair like a person overcome with weariness. He decided to abandon the water, and advised his sons to venture no more about the Rapids. Both his manner and appearance were changed. Calm and deliberate before, he became thoughtful and serious afterward. He had been borne, as it were, in the arms of a power so mighty that its impress was stamped on his features and on his mind. Through a slightly opened door he had seen a vision which awed and subdued him. He became reverent in a moment. He grew venerable in an hour.

Yet he had a strange, almost irrepressible desire to make this voyage immediately after the steamer was put on below the Falls. This wish was only increased when the first *Maid of the Mist* was superseded by the new and stauncher one. He insisted that it could be made with safety, and that it might be made a good pecuniary speculation.

The total number of visitors to the Fisheries Exhibition reached 1,000,000 during the course of Tuesday, the last day of July, that is to say, within sixty-eight days of the opening on Whit Monday. This gives an average of about 14,700 visitors per diem. The two largest days were Whit Monday and Tuesday, with 42,941 and 29,446 visitors respectively.

For cementing rubber or gutta-percha to metal Mr. Moritz Grossman, in his "Year Book" for 1883, gives the following recipe:—Pulverised shellac, dissolved in ten times its weight of pure ammonia. In three days the mixture will be of the required consistency. The ammonia penetrates the rubber, and enables the shellac to take a firm hold, but as it all evaporates in time, the rubber is immovably fastened to the metal, and neither gas nor water will remove it.

PRINCIPLES OF DRESS REFORM.

By E. M. King.

It is the theory of Herbert Spencer that imperfection in mankind is due to its being out of harmony with its surroundings. That "all evil results from the non-adaptation of constitution to conditions." That this non-adaptation is caused by having a faculty in excess or a faculty that is deficient. That finally, by the working of an unalterable law, "all excess and all deficiency must disappear, that is, that all unfitness must disappear; that is, all imperfection must disappear." And, in this way, humanity must become completely adapted to its conditions, that is to say perfect.*

There seems to me to be a flaw in this reasoning. There is a tacit assumption that "conditions" are perfect, and therefore that if character is adapted to conditions it must necessarily become perfect also. But the conditions which surround men may not be perfect, they may tend to diminish a good faculty, and to increase a bad one, and this will not lead to perfection, but the reverse. Writers on social science whose works I have read do not seem to have recognised that mankind has two surroundings or conditions; his natural surroundings and his social surroundings. The former, or laws of nature, are fixed and inexorable; the latter, or social laws, are not as "H. S." affirms,† "sure and inflexible," but fluctuating, and continually made and unmade by society. I am not speaking here of mere social etiquette, but of all sociological laws.

We are conscious, daily and hourly, of the powerful influence of our social surroundings; they even appear to shut us out from, or blind our eyes to, the more sure, but less apparent, laws of nature. Very often the two sets of laws are at variance, and thus it happens that an individual may be perfectly in harmony with his social surroundings or conditions, but out of harmony with his natural surroundings or conditions. Our social surroundings, for a time at least, shield us from some of the pains and penalties of disobeying—or being out of harmony with—the laws of nature. When this state of contradiction, or antagonism, is arrived at, the punishment appears to be, by slow degrees, distributed from the individual to the class, or race, or nation which disobeys.

For instance, a man dealing dishonestly where there is a low standard of honesty in trade, suffers little from his social surroundings—he is in harmony with them, and they with him; but instead of himself and his trade moving on to perfection by this adaptation of constitution to conditions, he is moving on to degradation of character and his trade sinking to decay and ruin. Again, a man who lives an impure life, in a society which allows laxity of morals as excusable in men, is in harmony with his social surroundings, although he is at war with the laws of nature. His social surroundings are increasing his bad faculties and diminishing his good ones, and in the end that class, or race, or nation so degrading character to its social conditions, meets with its due reward.

Before humanity reaches perfection it has a two-fold work before it, not only to adapt character, or constitution, to conditions, but so to modify, alter, and improve these latter, that they shall be favourable to the highest development of his faculties, whether intellectual, moral, or physical.

Of necessity, then, the first step of every reformer must be to put himself out of harmony with his immediate or social surrounding or conditions. Socrates, Lloyd Garrison, and other such reformers, were all glorious men, who had

* "Social Statics," chap. 2. † *Ibid.*, p. 55.

a (good) "faculty in excess," which no laws, radical or social, could diminish. They voluntarily put themselves out of harmony with their surroundings, and had to endure the hate, abuse, ridicule, and misconstruction which their disobedience to the social laws of the time entailed upon them.

The fashionably-dressed woman is completely in harmony with her surroundings. She feels this in herself by a delightful sense of self-complacency. Society pets her, and "pays attention" to her, for, on the whole, society likes fashionably-dressed women, however much fashion in the abstract may be abused. But the more the fashionable woman is in harmony with her surroundings, and the more society is in harmony with her, so much the worse for society and for women.

When people condemn fashion, they usually mean only the most glaring violations of good taste which they may happen to observe—especially if it is personally inconvenient to them — which fashion from time to time introduces. And this is generally only objected to on its first appearance, for the eye soon gets reconciled to it and ceases to object, and so the harmony between the fashionable woman and her social surroundings is soon re-established. While this even balance is kept up no reform can be expected to arise on either side.

Something more is required than this occasional protest against, and avoidance of, the passing fashion-folly of the day.

We must look a little deeper, and see what it is in ourselves and in our ordinary mode of dress which makes us liable to be caught by, and made victims of, the contagious disease of Fashion.

It is this: that our ordinary mode of dress is not constructed with any reference to the requirements of the body, nor to the beauty of its natural form. It has, therefore, no firm and lasting basis in Reason. Nothing from which beauty can naturally grow as out of a stem—nothing upon which to base the eternal canons of loveliness—nothing, in short, which can permanently ensure us either fitness or beauty in our dress. Until, therefore, we lay the right foundation, any utility or beauty which those who pander to our morbid desire for change may offer us, will only come by chance or accident, and be swept away by the next turn of the tide.

From my point of view, then, with regard to dress reform, the necessity, scope, and aim of which I have endeavoured logically to put before your readers, my fifth requirement—that we must not depart too conspicuously from the ordinary dress of the time—means that we must depart a little conspicuously. Bear in mind that for this, as for every other reform, two things are necessary—reform of the individual, and reform of the social medium in which the individual lives, and though the first process may be done in secret, every true-hearted and courageous reformer is bound to go on to the second, and is called upon to take a step which must, for the time, put him out of harmony with his surroundings.

Dress appeals to the eye. It is through the eye that society has been educated in bad taste, and that our social surroundings tend to the increase of women's bad faculties and to the decrease of their good ones. We must therefore begin this second process by an appeal to the eye, in however small a degree, so as gradually to modify, alter, and finally change the condition of our social environment, so that it may become favourable to the development of our best faculties, moral, intellectual, and physical.

For this reason also (that dress appeals to the eye) I have struck here the keynote of beauty rather than of health, though on this latter head as much, or more, remains to be said which has not yet been said.

Those who are alive to the necessity of reform must be content to remain in a state of change or transition until the twofold revolution in mind and act is completed. This is not the "morbid" desire for change, but the healthy desire for perfection. Those who desire progress in reform must dread any bars placed across the road. Such a bar, I consider, the advice of "Pedestrienne"—that a garment must be of a certain shape and a certain definite width in inches. Any hard-and-fast line of this kind is a bar to progress. Such a one as this induces women to think that in making some little paltry advance they have done all that is needful, and that they may after that go comfortably to sleep for the next generation or two.

No mental or moral faculty has been called into active exercise; they have simply accepted a fashion which some individual or some society has succeeded in inducing them to wear, just as they would have received it from the shops or the fashion-books.

I am so tired of hearing that women naturally shrink from making themselves "conspicuous." Everyone "naturally shrinks" from doing what is disagreeable to them, because every one naturally shrinks from the pain of putting themselves out of harmony with their surroundings. But this is no reason why they should not do their duty, and dress reform is the imperative duty of every woman who can think, and who can raise a finger to act.

But it is not the fact that women naturally shrink from making themselves conspicuous. The whole sex, both from natural and acquired propensities, loves to make itself conspicuous. In comparison with men, we may be called the personally-conspicuous sex. We ought, therefore, to be proud of being conspicuous in the cause of reason, as we have hitherto been in the cause of folly.

But I would spare my sex as much as possible not because we naturally shrink from making ourselves conspicuous, but because morbid self-consciousness and personal vanity have been so largely increased in us by our social environment that it gives us much greater pain than it does men to put ourselves out of harmony with it in a matter which touches so sharply on these tender points.

As far as I am able, I strive to act upon the social medium, so that as little pain as possible may be felt in taking this first painful step. More especially I address myself to men, by arguments which they (some of them) can follow and appreciate.

If they see flaws in my reasoning let them point them out. If they think them sound, let them help us.

The Pilsen-Joel and General Electric Light Company (Limited), which possesses in the Pilsen lamp one of the best arc regulators yet invented, have presented a petition for winding-up.

A Novel Literary Scheme.—In pursuance of a suggestion that the Parcels Post may be so utilised as to enable readers of current literature to see the magazines and reviews at a reduced cost, a central agency has been established for the promotion of this object. The scheme is, in brief, an adaptation of the principle of the circulating library, a selected parcel of periodical literature being passed on from one subscriber to another by mutual understanding. The experiment may be regarded with interest from several points of view; it is claimed that, if successful, it should rather increase than restrict the demand for current literature by placing it within the reach of a much larger class than hitherto. All particulars may be obtained of the Parcels Post Periodical Press Exchange, 160, Fleet-street, E.C.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. III.

It has been the object of the former two papers to give some idea of the nature and properties of that interesting group of compounds, starch, cellulose, and dextrin. Viewing these bodies in their relation to plant-life, there is every reason to believe that starch is the first-formed of the three; and that the plant, in the act of growing, draws on its store of starch for the production of cellulose, as that material is required for the building up of its structure. So far, the process is one of development: from one organised substance, another, to be used for a more special purpose, is formed. Coming to the dextrin, we find evidence, not of life, but of death; the starch-cells which, despite their minuteness, are so delicately fashioned, have lost all trace of structure, and are transformed into a perfectly homogeneous body. Notwithstanding this (as already known to the reader), the chemical composition is as yet unaltered, so far as the number of atoms composing the molecule is concerned. The starch undergoes yet another stage of degeneration within the grain, by which it is converted into sugar; the gum and sugar of the cereals having thus a common origin, are classed together in the analyses given at the commencement of these papers.

Starch, dextrin, and a number of other compounds are frequently termed "carbo-hydrates." This name is applied because they contain the element carbon combined with hydrogen and oxygen in the proportions of those elements necessary to form water. Thus $C_6H_{10}O_5$ may be viewed as six atoms of carbon and five molecules of H_2O, although the actual groupings of the atoms within the molecule is undoubtedly more complicated than this idea represents. Reference has been made to this classification as carbo-hydrates, because we thus have a connecting link between the starch group and sugar, for this latter body is also a carbo-hydrate, having the formula $C_6H_{12}O_6$. The number of carbon atoms is again the same; but instead of five, there are here six molecules of H_2O. Starch passing through the modifications of soluble starch and dextrin is changed into sugar by a very simple chemical operation:—

$$C_6H_{10}O_5 + H_2O = C_6H_{12}O_6.$$

To changes of this kind, which consist of the assimilation of the elements of water by a compound, the name "hydrolysis" has been applied. Starch and water if left to themselves do not readily combine to produce sugar, but their combination may be effected by a number of bodies which do not necessarily themselves undergo change during the hydrolysis. Several of the dilute acids may be used for this purpose; the saliva also possesses the property in a remarkable degree. This latter fact admits of easy experimental proof in the following manner. Make a tolerably stiff solution of arrowroot or cornflour by boiling with water only; let it cool, and when lukewarm, place a spoonful in the mouth, and mix it thoroughly with the saliva. Retain the mixture in the mouth, and very shortly the solution becomes thin and watery, and acquires a sweet taste; the starch has by that time become almost wholly converted into sugar. This change is also, under certain circumstances, effected by another group of bodies, and these are of special interest, because they are constituents of the grain itself.

Sugar is so familiar to all, that it becomes scarcely necessary to mention that it is a soluble body, and that its great and leading character is its sweetness. Its further properties must be dealt with somewhat later, and, as its production from starch is the foundation of some most important industries, we shall then describe these properties in detail. [The foot-note appended by the Editor to the last article of this series, giving a second version of the discovery of dextrin, affords a clue to one industry, at least, to which reference is here made.]

All grains contain a certain small proportion of fat. This is not, however, a very important constituent. Chemical analysis shows the fats to be compounds consisting of carbon, hydrogen, and a small proportion of oxygen.

We must in the next place turn our attention to remaining group of constituents of the cereals. These will be found in the table of analyses, given at the head of the first paper, classed under the term "albuminoids." The percentage varies from 7·2 in rice to 16·0 in oats: wheat again occupies an intermediate position, with a percentage of 10·9. The albuminoids differ essentially in chemical composition from the bodies we have heretofore studied, in that they contain in addition to carbon, hydrogen, and oxygen, the elements, nitrogen and sulphur. On analysis they are found, on the average, to consist of carbon 53·3, hydrogen 7·1, nitrogen, 15·7, oxygen 22·1, and sulphur 1·8 per cent. From these proportions it is impossible to deduce a simple formula. The sulphur is only present in small quantity, but as in a molecule we must have at least one atom, we can get no formula simpler than that calculated by Lieberkuhn, which is written $C_{72}H_{112}N_{18}O_{22}S$.

The albuminoids are so-called because, both in chemical composition and properties, they are strikingly like albumen; this latter substance is well known to everybody, occurring, as it does, in an almost pure form in white of egg.

When wheat-flour is made into a paste, and then washed with a large quantity of water, a separation into three distinct substances occurs. As already described, starch is one of these substances, and renders the washing water milky in appearance; gluten is another, and remains in the hand. It is a very sticky, elastic body, of a light-grey colour. On setting the washing water aside to rest, the starch falls to the bottom; remaining in solution there is, however, a little dextrin and sugar, and also another highly important substance, viz., vegetable albumen. The gluten on the one hand, and the vegetable albumen on the other, are two of the most important of the group of albuminoids; they represent respectively the soluble and the insoluble albuminoids; this of itself is a most important subdivision of the group. The soluble albuminoids consist of two separate bodies—vegetable albumen, and legumin or vegetable casein. On boiling the solution, the albumen coagulates, and is deposited in white flakes; the albumen thus obtained is to all intents and purposes identical with that of the white of egg and of blood.

Another albuminoid of importance is found in the husk or bran of wheat. This body is soluble in water, and possesses in a remarkable degree the property of converting starch into sugar; hence if an infusion of bran be added to starch solution, the latter speedily becomes thin and watery. As a result of this action, bread made of whole meal has always a specially sweet taste; this is often so pronounced that the bread after very short use becomes distasteful to many. Cerealin shares with some of the other albuminoids this peculiar property.

Gluten is quite insoluble in water, and has scarcely any taste; when dry, it closely resembles glue in appearance; in the grain, it exists in a pulverulent form, and acquires its toughness and elasticity on the addition of water. The toughness of gluten gives dough made from wheat-flour its peculiar elasticity, hence it becomes so deliciously light by

the production from any cause of air bubbles within its mass. Barley and other grains contain little or no gluten, and so do not yield the same highly elastic dough. Moist gluten putrefies with great readiness; in the manufacture of wheat-starch, the gluten is removed in this manner. Gluten is not a single compound, but may be separated into two bodies, known respectively as vegetable fibrin and glutin.

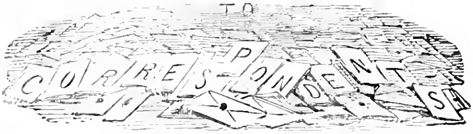
This brings us to the close of a very brief description of the principal constituents of the cereals. Our next paper must commence to deal with the chemistry of some of their uses. The production of bread will naturally occupy the first place in this series of studies.

Editorial Gossip.

I have been told, by one who ought to know, that the analysis of Sir W. Herschel's papers by Messrs. Holden and Hastings referred to in the Gossip at p. 59 is good and trustworthy work. I willingly notify this. It shows that the same man who writing anonymously has been dishonest and untruthful is capable of better things when working in open daylight. The same correspondent who speaks with respect and something like gratitude (for reasons which I need not explain) of Holden's analysis of the elder Herschel's papers, appeals against my reference to a long-past offence against the unwritten laws of the literary commonwealth. It is unfortunately (for the offender, but fortunately for the world) a part of the punishment of offences against honesty that the recollection remains long after the mischief may have been repaired. I cannot but recollect, however, the terms in which this particular offence was spoken of (see the *English Mechanic*, Vol. XX., p. 346) both in English and American papers, when as yet it was not known, and seemed likely to remain for ever unknown, who the offender might be. If there has been unfairness in this matter it has been in not directing against the offender, so soon as his identity was known, the condemnation which had been passed upon the anonymous writer,—even when it was supposed by many (naturally enough) that he was too far below contempt to be worth castigating.

In a singular way a singular misprint occurs in the paragraph on the size of atoms on p. 76, 1st col. In converting into ordinary measures the metric relations which Prof. Thomson rather affectedly (considering he was addressing a popular audience) employed, I wrote that such and such numbers might *without serious error* be represented so and so. For the words italicised were substituted, in a paragraph for the *Newcastle Weekly Chronicle*, *without science even!* This was duly corrected in a proof received by me at Bournemouth, and the paragraph appeared correctly in the Newcastle paper. Unfortunately another proof was sent to me in town, and I cut out the paragraph from this uncorrected proof, forgetting that there was a serious error (without science even) in *that* "copy."

⁂ The Editor has been prevented by ill-health, the result of recent railway collision, from completing for this week an instalment of his article on Sun-Spots, or his Answers to Correspondents. The articles on the Earth's Rotundity were, fortunately, completed before the accident. The lectures announced for the next fortnight will not be given, but he hopes to be able to give those announced for Tunbridge Wells and Hawkhurst.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

CHOLERA.

[892]—As an old Indian who passed through two of the worst visitations known in the North-West during this century, I can fully endorse the recommendation of Mr. Herring. The prescription he gives, or others very similar, proved most beneficial on these occasions; only they must be preceded by a purgative to remove the specific poison that is already at work in the system.

For this purpose was most extensively and successfully employed a pill containing 5 grains calomel, 1 grain rhubarb, ½ grain opium; to be made up with oil of cloves or oil of cinnamon. This was considered the dose for a woman or child, two being given to a man, and the pill should, if possible, be swallowed dry, without any liquid.

When the vomiting was too severe to allow even this pill to be kept down, it was found beneficial to administer in small quantities (say a dessert-spoonful) carbonate of soda (10 grains), or powdered magnesia (15 grains), dissolved in half-pint of filtered water—which seldom failed to allay both the vomiting and the distressing thirst.

It may be added that the patient should be kept warm with flannel wrapped round the body, and in extreme cases hot water bottles or hot bricks applied to the feet. J. W. B.

ANOTHER LARGE SUN-SPOT.

[893]—I hope you will not think I am troubling you too much about sun-spots in writing to say there is now another spot on the sun, so large as to be visible to the unaided eyes through smoked glass, I and several friends having seen it distinctly in that way on Saturday and yesterday (July 28 and 29).

It is a spot that has been on the sun's disc more than a week, and is now getting near the western edge, but I don't think it has been visible to the unaided eye before Saturday, as I looked for it several times before without success.

I am much obliged to "F.R.A.S." for the information he gives in No. 91 of Knowledge (Letter 880, page 60) about the tremendous area of the disturbance comprised in the fine group of spots visible to the unaided eye at the beginning of last month. The information does interest me very much. There is considerable difference between that case and the present one, for in that case the one spot, as it appeared to the unaided eye, was really, as viewed in the telescope, composed of several distinct spots very close together, the penumbra of each being distinctly separated from the others, whereas in the present case it is one entire spot as regards the penumbra, the only division being in the actual umbra, which is cut up into several very irregular-shaped parts, and I believe it is the gradual opening out, within the last day or two, of two or three of these previously separate parts of the umbra, and their consequent meeting or joining together, which has caused the spot to become visible to the unaided eye.

The observation of sun-spots is a subject in which I take very great interest, and devote every opportunity I have to it, and it is in the hope that my communications are of some little interest to you and some at least of the readers of Knowledge that I venture to trouble you with them so often. Of course, if you regard them at all otherwise I hope you will not hesitate to intimate as much, as I have no desire to be an unwelcome trespasser on either your valuable time or space. Excelsior.

Huddersfield, *July* 30, 1883.

AMERICAN-ENGLISH.

[894]—I take the liberty of sending you a few notes on the subject of "British and American-English," suggested by your very interesting essay in "Leisure Readings," Vol. I.

P. 185—*Abergavenny*. My family resided in this place for a great many years, and I never heard it spoken of under any other name than *Aberga'ny* until I went to school, where I had to use the former name to the exclusion of the latter.

P. 195—"*Mad.*" In Devonshire, as in America, the word is used to express *anger, crossness, ill-temper*. "Don't be so mad!" "He is as mad as he can be." In both cases meaning cross, out of temper. I remember hearing that, when a child was born in a certain family, the neighbours said, "Here is another mad G—— come," meaning that the child had possibly inherited the family temper, which was not very gentle.

P. 195—*Ordinary*. In Cambridgeshire and Suffolk I have often heard this word used to express inferiority, as in America. "An ordinary child" was "a plain child."

P. 199—*Reckon*. This word was formerly common in Sussex in the sense of "I believe," "I think," "It is probable, "He will go there to-morrow, I reckon."

P. 202—*Sure*. Formerly used in Sussex as it is now said to be used in America.

I am an old woman, in my 80th year, and have outlived most of these expressions, but I believe that they are genuine English, although provincial. MARY P. MERRIFIELD.

ERRATUM.

[895]—Your printer has made an omission in my description of the Magic Square in page 61 (888), which, in a manner, makes it unintelligible. It should run thus (fourth line from top of page): —"By the angles from the corners or the middles to the centre, whether right, acute, or obtuse; by the four corner, four middle and central cells; which will still hold good, &c." G. S.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By Richard A. Proctor.

PART XI.

In Examples 12 and 13 we notice that, although the number of the triangles which can be constructed under the given conditions is infinite, yet all the triangles belong to a certain set, or family. In Ex. 12, the vertices of all the triangles on the base A B, lie on the circumference of the circle E F D. In Example 13 there is no curve along which the vertices are shown to lie; but if the reader were carefully to construct a number of triangles according to the method described in that example, he would find that the vertices all lie upon a certain curve, which however is not a circle.

These considerations introduce us to an important class of problems, called problems on *loci*.

If all points which satisfy certain relations can be shown to lie on a certain line (straight or curved), and if every point on this line satisfy the given relations, the line is called the *locus* (or place) of such points.

A few examples will serve better than a formal statement to show (1), the nature of *plane loci*; (2), the sort of problems founded on them; and (3), the methods available for readily solving such problems. It must be premised that the complete solution of such problems requires that it should be shown that both the conditions stated in the above definition of a locus should be fulfilled.

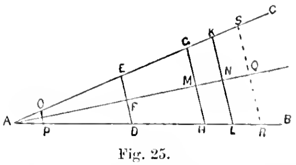


Fig. 25.

Ex. 16.—*The straight lines A B, A C (Fig. 25) intersect in A. From A equal parts A D and A E are cut off from A B, A C respectively. E D is bisected in F. Find the locus of all such points as F.*

Take A G equal to A H, A K equal to A L, and bisect G H in M, K L in N. Then it seems from the figure that the locus must be a straight line, whose direction is such as will carry it through A. A moment's consideration shows that the locus—whatever it be—must pass up to A; for if we conceive equal lines, A O, A P, very very small, the bisection of O P will be very very near to A. Again it will occur, from a consideration of the figure, that the locus is a straight line bisecting the angle A. Now, assuming for the moment that A F M N is such a line, we see that the triangles, A N L, A N K are equal in every respect (Euc. I., 4), and this leads us at once to the proof we require. For, because the base, K L, of the isosceles triangle A K L is bisected in N, therefore N lies on the bisector of the angle K A L. Similarly, every point obtained in accordance with the given conditions lies on the bisector of the angle K A L. It is clear, also, that every point in the bisector of the angle K A L fulfils the required conditions. For, let Q be such a point, and draw S Q R at right angles to A Q; then the triangles A Q S and A Q R are equal in every respect. (Euc. I., 26.) Therefore, A S is equal to A R, and S Q to S R; that is, Q is a point fulfilling the required conditions.

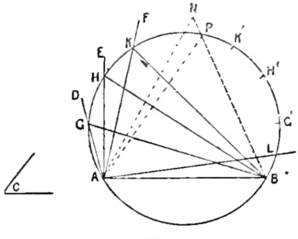


Fig. 26.

Points in the production of Q A beyond A cannot be said to fulfil the requisite conditions, because nothing has been said of the production of B A and C A beyond A.

Ex. 17.—*Determine the locus of the vertices of all the triangles which stand upon a given base, and have a given vertical angle.*

Let A B (Fig. 26) be the given base, C the given angle.

Draw from A straight lines, A D, A E, A F, and from B draw B G, B H, B K, to make, with A D, A E, A F, respectively, the angles B G A, B H A, and B K A equal to the angle C.*

We see at once that G, H, and K do not lie in a straight line, so that we gather that the locus is circular, since loci of other figures are not dealt with in deductions from Euclid.

Now we notice that we might have drawn our lines from B instead of A, and that therefore the locus must have points, G', H', K', situated in the same manner with respect to B as G, H, and K with respect to A.

It is already clear that a circle passing through, or near to A and B, contains all the vertices. We see also that the circle cannot but pass *through* A and B; for if we draw A L very very near to A B, then B L drawn so as to make the angle B L A equal to C, will clearly meet A L in a point very very near to B. We describe, then, a circle through A and B, and also (of course the circle is drawn by hand through the points G, H, K, &c.

At this point we cannot fail to be reminded of III., 21, which tells us that all the angles in the same segment of a circle are equal. We see, therefore, that our surmise is correct, and that the circular segment on A B, containing an angle equal to the angle C, is the locus we require. All the points on this segment fulfil the required condition; but points on the remaining segment, A M B, do not do so. If triangles are to be drawn on one side only of A B, the segment, A K B, contains *all* the required points. For if any point, N, without the segment fulfil the given condition, join N A and N B; let N B cut the segment, A K B, in P, and join A P. Then the angle, A N B, is equal to C (*hyp.*), but the angle A P B is equal to C (Euc. III., 21). Therefore, the angle, A P B, is equal to the angle A N B, the greater (Euc. I., 16) to the less, which is absurd. In like manner no point within the segment fulfils the required conditions. Therefore, the segment, A K B, is the required locus.

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* There is no problem in Euclid which shows us how to do this, but of course there is no difficulty in the matter. Among the subsidiary problems mentioned in the first part, one should be given showing how to draw a straight line in the manner required. Here, however, we do not require the problem at all; since we are dealing with the practical construction of the figure—about which there is no difficulty—not with the mathematical treatment of the problem.

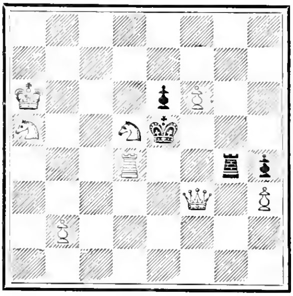
Our Chess Column.

By Mephisto.

PROBLEM No. 90.—SECOND PRIZE THREE-MOVER IN THE PROBLEM TOURNAMENT OF THE GERMAN CHESS ASSOCIATION.

By Herman Ascheboug, Christiania.

Black.



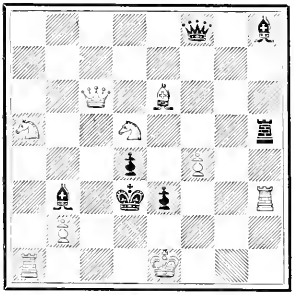
White.

White to play and mate in three moves.

PROBLEM No. 91.

By W. Terrill.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Problem No. 88, p. 32.

1. Kt to K5	K takes Kt, or	1.	K to Kt4
2. Q to B sq	K moves	2. Q to B sq. (ch)	K takes P
3. Q mates accordingly.		3. Kt to B6 mate.	

Prize Problem No. 89, p. 64.

1. Q to R8.

1.	R (R2) takes Q, or	1.	R (Kt sq) takes Q
2. Kt to Q7 and mates accordingly		2. Kt takes KtP and mates acc.	

or

1.	Q takes R	1.	R (Kt sq) to Kt2
2. Q takes R (ch)	Any move	2. Kt to Q7	R takes Kt (best)
3. Q to R sq mate.		3. Q to K5 mate.	

The other numerous variations of this beautiful problem are obvious.

*** Correction in the game on p. 80—White's fourth move should be B to Kt5.

Correspondents will kindly excuse omissions or delay in our answers on account of the late tournaments. We have made a terrestrial excursion in the Chess Domain; but we will again revert to our former habit of giving Chess for its own sake, and disclose to our readers the beauties and intellectual charms of our noble game, free of earthly dust.

As an exception to prove the rule of correctness, a mystifying error has occurred in our article on the tournament in our last number, p. 79, in the last paragraph. We meant to speak of Blackburne's "powerful" play, which somehow got converted into "powerless."

In the second tournament at Nuremberg, Herr S. Tarrasch, of Breslau, a young medical student, won the first prize. Messrs. Scheve, Lowenthal, and Neustadl tied for second, third, and fourth. Herr Rocamora, of Hamburg, won fifth, and Herr Bauer, sixth.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W.—Your solution of End game very interesting, but you will, no doubt, have seen by the solution published on p. 48 that the main variation is untenable on account of, firstly, advancing the P to R7; secondly, playing R to QR8; and thirdly, first checking on KB8 before playing R to KKt8, which allows the K to escape by Kt2, R3, Kt3, &c.

John.—In Problem 88, if 1. Kt to K5, K takes Kt. 2. Q to K7 (ch), K to B4. 3. Q to K6, K to Kt4, and there is no mate. 2. Q to B sq is correct; solution otherwise correct.

F. G. Richardson.—See above reply.

A. C. Gray.—We have had no special article on the subject, perhaps occasional references, such as in No. 73, p. 186; and No. 76, p. 228; or in No. 82, p. 313.

T. C.—Solutions incorrect; see p. 48.

Amateur.—We are sorry, almost ashamed, to say there is no suitable book on the openings in print. If you cannot get Cook's or Gossipp's, take Staunton or Wormold.

Stettin.—For solution of this fine Ending see p. 48.

Correct solutions received—Problems 86, 87, and 88 from Stettin. Problems 88 and 89 by W.

Problems received with thanks from W. Terrill, E. W. Smith, J. C. S.

Joseph Law.—Your diagnosis of the Prize Problem is not correct, as you may see by the solution published above. Fritz will therefore honour himself by cheerfully keeping the prize.

Contents of No. 92.

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LONDON: FRIDAY, AUG. 17, 1883.

CONTENTS OF No. 94.

A NATURALIST'S YEAR.

By GRANT ALLEN.

XIX.—A RABBIT'S SKULL.

WALKING this sunny August morning on the breezy saddle of the great chalk down, where the combes on either side are thickly overgrown with low scrub of stunted juniper bushes, at each step I take I see the twinkling white tails and tall ears of the pretty brown rabbits disappearing into their trusty burrows hidden cosily beneath the spreading bracken and the tangled gorse-runs. Poor timid wee things, how nervously they hurry and scurry away across the open patches, at the first sound of that dull thud which heralds to their watchful senses the approach of their heriditary foe, man, the possible hunter and probable gun-bearer! It shames me for my kind when I think that they took no heed at all of yonder philosophic old donkey, browzing quietly off the stemless thistles and dry carline on the windy hill-side, nor of the burly bell-wether himself who leads the flock of ruddled sheep in the deep hollow by the old yew-tree; but the moment they heard the distant rustle of my foot-fall upon the dry stems of bramble and bracken, they lifted the danger-signal of their white tails forthwith to their young ones among the fresh furze-brake, and darted off to their holes in dismay, as from the dreaded presence of a familiar enemy. It has come to this, then, that we men have waged needless war of extermination upon all these pretty wild creatures till they have learnt to condemn us all under a single category—*omnes uno ordine Achivos*—and to shrink instinctively even from those among us who would best appreciate their sympathy and their confidence. It must e'en be so, though even now much may be done, with care and patience, in the way of establishing friendly personal relations with these, our timid fellow-denizens of the soil of Britain. I will sit quiet awhile on the edge of the disused chalk-pit here till they have forgotten my sudden irruption, and by-and-by I shall no doubt be rewarded by seeing them peep cautiously out from the mouths of their burrows, with eyes and ears alert for every symptom of danger, till at last they begin to disregard my presence, and gambol freely on the open greensward before the very face of their once-suspected but now unheeded visitor.

See, here on the side of the pit is a dry, blanched skull, the sole remaining memento of some lost and nameless and forgotten bunny. Was he wounded by a casual gunshot, and left upon the ground undiscovered, I wonder; or was he hawked at and devoured at leisure by some vigilant night-prowling owl; or was he caught on the open, and miserably sucked to death by the sharp teeth of some cruel weasel? None of these, I can see at a glance; it was Nature itself that failed my poor rabbit; he died from sheer mal-adaptation to his own ingrained racial requirements. Look closely at his lower jaw, and you will observe that the great gnawing teeth—the incisors from which the rodent group takes its scientific name—have grown out into an immense arch, until they have doubled in again upon themselves, and at last caused the death of their unhappy owner by starvation. I have seen rabbits' teeth in this same condition before, and the reason for it is easy enough to understand. The big incisors of rodents have no roots, but spring from a permanent pulp, so that they continue growing uninterruptedly throughout the entire life of the animal. This arrangement has naturally been brought about by survival of the fittest, because the rodents have to pass their days in a perpetual round of gnawing, and they can't even be happy without something or other hard on which to exercise their teeth, as everybody has observed in the case of tame squirrels. But in order to prevent the teeth from getting entirely worn away by such continual use, it is necessary that they should keep on always growing from below, to make up for the unceasing waste above. Now, in the dead rabbit before us, the two jaws were placed at a slightly irregular angle—too much underhung, as the dentists call it in the human species—and therefore the teeth did not meet, as they ought to do, and get worn off at the end by attrition against one another. The consequence has been that the incisors have bent round into a perfect semi-circle, and so killed the rabbit by preventing him from opening or shutting his jaws properly.

Even in the normal state the teeth of hares and rabbits are very interesting from their evolutionary implications. This small group of rodents preserves for us, to some slight extent, an early intermediate stage between the original central mammalian stock and the thorough-going modern rodents. If you look at the skull of a squirrel or a mouse, or any other typical rodent, you will find that it has only two kinds of teeth, incisors and molars, without any canines; and also that the incisors number two only in each jaw. This is clearly a great reduction of the primitive pattern, and it is accompanied by a great gap between the large specialised incisors and the far smaller but still somewhat peculiar molars. But if you examine the upper jaw of a hare or a rabbit, you will find that it contains, besides the big pair of working incisors, a small rudimentary pair, immediately behind them, and quite useless for any practical purpose. They are, in fact, a survival from the time when the ancestors of the rodents had at least four working incisors in each jaw; and they mark out the hares and rabbits as being an earlier, more primitive branch of the rodent type than the two-incisored rodents, like the squirrels, rats, and beavers. I say at least four incisors, because we have good reason to suppose that there were once six; indeed, the young hare has still six in the upper jaw at birth, but two of them fall out while he is still a mere baby. This reappearance of ancestral peculiarities in very young animals is, we know, one of the greatest aids to the reconstruction of lost or doubtful pedigrees.

Fossil forms, again, often help us to piece out the scanty evidence thus afforded us by living species; and one good bit of evidence in this direction is forthcoming even for

the genealogy of so isolated and divergent a group as the rodents. South America is a perfect mine of antiquated types, living or extinct; its long separation from the rest of the world, before the restoration of communications *viâ* the Isthmus of Panama, made it a sort of rival to Australia and the Cape of Good Hope as an area for the preservation of early forms, superseded elsewhere by the higher modifications which result from the fiercer competition and harder struggle for life in the great continents. In the pliocene deposits of La Plata, accordingly, there occur the bones of a singular early creature, a missing link in the way of a rodent, which helps to bridge over the gap to the main line of mammalian development. This most primitive known type of rodent (most primitive in organisation, I mean, for we have true squirrels and other perfect rodents much earlier in time) is known as *Mesotherium* (or Intermediate Beast), and has four incisors in its lower jaw. The second pair are smaller than the first, and are placed behind them; and in some other dental peculiarities this stranded type more nearly approaches the ordinary central form of mammals. In particular, the great incisors themselves are blunter and far less characteristically rodent-like than in all the existing species. Now, it is quite clear that the *raison d'être* of the rodents as a group, the fundamental difference upon which all their other class-differences depend, is the peculiar nature of their teeth; so that in this isolated South American form we have, so to speak, a central mammalian type in the very act of growing into a true rodent. In many ways Mesotherium recalls the hoofed animals, and especially that aberrant little Syrian creature, the so-called coney, the last survivor of an order now otherwise quite extinct. There are other points in which it resembles those other archaic South American mammals, the sloths and armadillos; and altogether we may consider it as a late lingering form of a very primitive rodent type, preserved in the once insular Neotropical region long after all its kind had been lived down elsewhere by the more advanced and perfected true rodents. Thus, we may fairly conclude that the ancestors of squirrels and rabbits probably started from a type hardly superior in organisation to the Australian marsupials, and linked on either hand to the hoofed animals and to the edentates; that they gradually lost the two useless incisors in either jaw, except in the case of the hare and rabbit section, which still retains one pair in a rudimentary condition; and that at the same time they gradually modified the remaining and functional pair in adaptation to their special habits, till at last they grew into the very long and efficient, sharp, cutting tools with whose appearance we are so familiar in the case of the rabbit, the mouse, and the squirrel.

THE CHEMISTRY OF COOKERY.

XV.

By W. Mattieu Williams.

A CORRESPONDENT of Manchester asks me which is the most nutritious, a slice of English beef in its own gravy, or the browned morsel as served in an Italian restaurant with the burnt sugar addition to the gravy?

This is a very fair question and not difficult to answer. If both are equally cooked, neither over-done nor under-done, they must contain weight for weight exactly the same constituents in equally digestible form, so far as chemical composition is concerned. Whether they will actually be digested with equal facility and assimilated with equal completeness depends upon something else not measurable by chemical analysis, viz., the relish with which they are respectively eaten. To some persons the undisguised fleshiness of the English slice, especially if underdone, is very repugnant. To these the corresponding morsel, cooked according to Francatelli rather than Mrs. Beeton, would be more nutritious. To the carnivorous John Bull, who regards such dishes as "nasty French messes," of questionable composition, the slice of unmistakable ox flesh, from a visible joint, would obtain all the advantages of appreciative mastication and that sympathy between the brain and the stomach, which is so powerful, that when discordantly exerted may produce the effects that are recorded in the case of the sporting traveller, who was invited by a Red Indian chief to a "dog-fight," and ate with relish the savoury dishes at what he supposed to be a preliminary banquet. Digestion was tranquilly and healthfully proceeding, under the soothing influence of the calumet, when he asked the chief when the fight would commence. On being told that it was over, and that in the final *ragout* he had praised so highly the last puppy-dog possessed by the tribe had been cooked in his honour, the normal course of digestion of the honoured guest was completely reversed.

Reverting to the fat used in frying, and the necessity of its purification, I may illustrate the principle on which it should be conducted by describing the method adopted in the refining of mineral oils, such as petroleum or the paraffin distillates of bituminous shales. These are dark, tarry liquids of treacle-like consistency, with a strong and offensive odour. Nevertheless they are, at but little cost, converted into the "crystal oil" used for lamps, and that beautiful pearly substance, the solid, translucent paraffin now so largely used in the manufacture of candles. Besides these, we obtain from the same dirty source an intermediate substance, the well-known "*Vaseline*," now becoming the basis of most of the ointments of the pharmacopœia. This purification is effected by agitation with sulphuric acid, which partly carbonises and partly combines with the impurities, and separates them in the form of a foul and acrid black mess, known technically as "acid tar." When I was engaged in the distillation of cannel and shale in Flintshire, this acid tar was a terrible bugbear. It found its way mysteriously into the Alyn river, and poisoned the trout; but now, if I am correctly informed, the Scotch manufacturers have turned it to profitable account.

Animal fat and vegetable oils are similarly purified. Very objectionable refuse fat of various kinds is thus made into tallow, or material for the soap-maker, and grease for lubricating machinery. Unsavoury stories have been told about the manufacture of butter from Thames mud or the nodules of fat that are gathered therefrom by the mudlarks, but they are all false. It may be possible to purify fatty matter from the foulest of admixtures, and do this so completely as to produce a soft, tasteless fat, *i.e.*, a butter substitute, but such a curiosity would cost more than half-a-crown per pound, and therefore the market is safe, especially as the degree of purification required for soap-making and machinery grease costs but little, and the demand for such fat is very great.

These methods of purification are not available in the kitchen, as oil of vitriol is a vicious compound. During the siege of Paris some of the Academicians devoted themselves very earnestly to the subject of the purification of fat in order to produce what they termed "siege butter" from the refuse of slaughter-houses, &c., and edible salad oils from crude colza oil, the rancid fish oils used by the leather-dresser, &c. Those who are specially interested in the subject may find some curious papers in the *Comptes*

Rendus of that period. In Vol. 71, page 36, M. Boillot describes his method of mixing kitchen-stuff and other refuse fat with lime-water, agitating the mixture when heated, and then neutralising with an acid. The product thus obtained is described as admirably adapted for culinary operations, and the method is applicable to the purpose here under consideration.

Further on in the same volume is a "Note on Suets and Alimentary Fats" by M. Dubrunfaut, who tells us that the most tainted of alimentary fats and rancid oils may be deprived of their bad odours by "appropriate frying." His method is to raise the temperature of the fat to 140° to 150° Centigrade (284° to 302° Fahr.) in a frying-pan; then cautiously sprinkle upon it small quantities of water. The steam carries off the volatile fatty acids producing the rancidity in such as fish-oils, and also the neutral offensive fatty matters that are decomposed by the heat. In another paper by M. Fua this method is applied to the removal of cellular tissue of crude fats from slaughter-houses. It is really nothing more than the old farm-house proceeding of "rendering" lard, by frying the membranous fat until the membranous matter is browned and aggregated into small nodules, which constitute the "scratchings"—a delicacy greatly relished by our British ploughboys at pig-killing time, but rather too rich in pork fat to supply a suitable meal for people of sedentary vocations.

The action of heat thus applied and long-continued is similar to that of the strong sulphuric acid. The impurities of the fat are organic matters more easily decomposible than the fat itself, or otherwise stated, they are dissociated into carbon and water at about 300° Fahr., which is a lower temperature than that required for the dissociation of the pure oil or fat (see No. 13 of this series, July 6th). By maintaining this temperature, these compounds become first caramelised, then carbonised nearly to blackness, and all their powers of offensiveness vanish, as such offence is due to slow decomposition of the original organic compounds, which now exist no longer, and the remaining caramel or carbon cinders being quite inoffensive or no further decomposible by atmospheric agency.

In the more violent factory process of purification by sulphuric acid the similar action which occurs is due to the powerful affinity of this acid for water; this may be strikingly shown by adding to thick syrup or pounded sugar about its own bulk of oil of vitriol, when a marvellous commotion occurs, and a magnified black cinder is produced by the separation of the water from the sugar.

The following simple practical formula may be reduced from these data. When a considerable quantity of much-used frying fat is accumulated, heat it to about 300° F., as indicated by the crackling of water when sprinkled on it, or, better still, by a properly constructed kitchen thermometer* graduated to about 400° F. Then pour the melted fat on hot water. This must be done carefully, as a large quantity of fat at 400° poured upon a small quantity of boiling water will illustrate the fact that water when suddenly heated is an explosive compound. The quantity of water should exceed that of the fat, and the pouring be done gradually. Then agitate the fat and water together, and, if the operator is sufficiently skilful and intelligent, the purification may be carried further by carefully boiling the water under the fat, and allowing its steam to pass through; but this is a little dangerous, on account of the possibility of what the practical chemist calls "bumping," or the sudden formation of a big bubble of steam that would kick a good deal of the superabundant fat into the fire.

Whether this supplementary boiling is carried out or not, the fat and the water should be left together to cool gradually, when a dark layer of carbonised impurities will be found resting on the surface of the water, and adhering to the bottom of the cake of fat. This may be peeled off and put into the waste grease-pot, to be further refined with the next operation. Ultimately the worst of it will sink to the bottom of the water. Then it is of no further value, and will be found to be a mere cinder.

* I have a vague impression of having seen such an instrument advertised, but cannot remember where, or by what maker. It may be worth his while to benefit the readers of Knowledge, and himself, by re-advertising therein, with particulars of price, &c.

HOW TO GET STRONG.

REDUCING FAT.

I HAVE received through the editor several letters relating to preparations—some patent medicines others offered in the form of prescriptions—for reducing fat without change of regimen or increase in the amount of exercise taken daily. Of all these preparations it is to be observed that they are advertised solely to make money. In every single case which has thus far been brought under my notice, the unfortunate heavy weight is invited to spend a large sum of money in the purchase of many bottles of some preparation in order that he may after many weeks find his weight notably reduced. Either the medicine is offered without any account of its ingredients, or in reply to letters the advertiser gives a prescription such as no chemist would be likely to mix, and such as the advertiser asserts that few chemists can mix properly even if willing. In one case, the corpulent are told in so many words that a number of bottles of the medicine are to be bought and consumed before any good effects will begin to be recognised. In the other the advertiser seems to offer a prescription gratis; but it comes really to the same thing; he knows that the persons who answer his advertisement will apply to him for the medicine, and in the cases which have come under my notice he asks a monstrous price for a preparation probably quite worthless and possibly (when used as recommended in large quantities) most mischievous. As to the value of any medicine for reducing fat, it should be noticed that only a long course of experiments conducted on a great number of persons, and under very various conditions, could possibly prove that a preparation was a specific against obesity,—and certainly no such experiments have been made in the case of any of the advertised medicines. If there were any medicine by which fat could certainly be diminished in a few weeks or months, it is *almost certain* that the constitution would be injured far more seriously by the medicine than it had been by obesity; and whereas undue fat can be removed by patient perseverance in health-giving regimen, the mischief done to the constitution by the long-continued use of nostrums for reducing fat would probably be permanent. Unquestionably it is most unwise for persons troubled with obesity to use any nostrum without medical advice; and I believe no medical man would advise the use of any one of the advertised cures for obesity.

I return to the various measures which a sensible person anxious to reduce fat without impairing the general health may use with advantage.

We come now to the measures by which the healthy action of the skin may be encouraged, and so fat reduced through increased perspiration. Exercise of course encourages perspiration, but I am for the moment speaking

not of exercise but of direct stimulation of the sudatory action.

First, the question may be asked whether Turkish baths, vapour baths, hydropathic treatment, and so forth, tend to reduce fat.

We may take the Turkish bath as a typical process for directly reducing weight by increased perspiration. Many have taken Turkish baths with the idea of diminishing their weight, and have been disappointed. I believe that those who most warmly advocate the use of the hot air baths, including those who are commercially interested in establishments where these baths can be taken, claim no fat-reducing effect from them. It is certain, as I know from my own experience, that you may take a Turkish bath five or six times in a week, and for several weeks in succession, without appreciably affecting the weight. Two or three pounds may be lost in the hot rooms, but then two or three pounds will be added to the weight through increased drinking during the next few hours.

Yet Turkish baths may be effectively used for the special purpose of reducing weight, if we remember that we are not to trust to the loss of weight by increased perspiration in the hot rooms, but to the improved condition of the skin. I have taken as many as twenty Turkish baths in a month without loss of weight, though probably some forty pounds' weight may have been actually parted with in the hot rooms; and I have lost as much as fifteen pounds of weight in ten days, indirectly through the action of five or six hot-air baths. This sounds paradoxical; but it is strictly true. In one case, I had been ill, and I took so many Turkish baths, as an easy way of keeping the skin in a healthy state when I was unable to take much exercise. In the other case, I wanted to reduce weight, and I took much exercise, especially just after each hot-air bath. The same amount of exercise by which one would lose a pound's weight under average conditions will remove two or three pounds' weight after a Turkish bath. Thus hot-air baths used as subsidiary to active exercise, are effective fat reducers,—used as a substitute for active exercise they do not reduce fat at all.

But the best method of at once improving the health and reducing the weight by increasing the action of the skin, is one which involves no expense and properly followed out supplies as much exercise, in itself, as one could get from a small gymnasium:—

Every morning after washing and thoroughly drying the head and neck, sponge with cold water (and a little soap, but not much if this is done every day) the arms shoulders chest and back, to the waist,—carefully rinsing. Then with a moderately-rough large towel, commence steady but brisk and energetic friction. *Tire* the right arm in drying and rubbing the left, then *tire* the left arm in doing the same by the right. Next tire both arms in drying and rubbing the chest. Now fling the towel over the right shoulder, and holding it with the right hand in front (overarm) and with the left hand behind (underarm), draw it steadily backwards and forwards across the neck, right shoulder, and upper back,—till both arms are again tired. Do the like with the neck, left shoulder, and upper back, interchanging hands. Throw the towel over both shoulders, and alternately pull with right hand and left hand. Keeping the towel still behind, let it fall to a little above the waist, and repeat the steady alternate hauling with right and left hands and arms. You now want a little rest. Take it while you sponge with cold water and a little soap from the waist to the knees and carefully rinse. Tire both arms drying, rubbing, and polishing from waist to knees in front. Pass the towel behind the back as in the last movement of the former series, and haul away alternately with right and left hand, till the back from waist to "small" is glowing and almost burning. Next, let the towel hang under the right thigh, and haul alternately upwards with right and left hands till the back of the right thigh, from seat to knee, is as nearly red hot as possible. Do the like with the left thigh. Again a rest is wanted. So take it while you sponge and rinse both legs from knee to foot. Then lastly, tire thoroughly both arms in drying, rubbing, and polishing both legs from knee to heels and toes. You can now dress at your leisure. There is no fear of taking cold, though you are likely to be rather slow at first, for the arms are or ought to be thoroughly tired out for awhile.

In the evening, just before going to bed, it is a capital plan to repeat the rubbing, without the sponging; or if you sponge at all it should be with warm water, drying before there is any time to feel cold; for the body is not able to bear cold well at night.

By a vigorous rubbing daily, in this way, and still better by two, the skin is kept not only clean, but as soft and free from rugosities as kid, its action is healthily stimulated, and the liver and kidneys are thus relieved from the overwork they have to accomplish when the sudatory glands are left clogged and hampered (as they are with many even of those who daily sponge and daintily dry the whole skin surface).

We come lastly to those forms of exercise which tell most effectively in reducing fat.

(To be continued.)

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(Continued from page 86.)

PARALLAX set a vertical mirror at a considerable height above the sea-level to face the sea horizon. Looking into this mirror you saw the sea horizon behind your head in the glass, and apparently at exactly the level of the middle of the eye pupils. Now it is obvious that when you look at your own eyes in a glass, the line of sight from an eye to the corresponding imaged eye is at right angles to the reflecting surface,—and to the glass, if the glass is perfectly even in thickness. Therefore, said Parallax to the bystanders (it was on the Hoe at Plymouth, in 1864, that *I* saw this mirror trick) the line from the eye to the imaged horizon, which you *see* at precisely the same level as your eye pupils, is perpendicular to the vertical mirror, or truly horizontal. Wherefore, my hearers, there is no depression of the sea horizon as astronomers tell us, and as their books show. (Here he had us, for too many of our books *do* show a monstrous depression such as has no existence in nature.)

Many, who *knew* the earth to be a globe looked into Parallax's mirror and were perplexed. His reasoning was correct. If the sea horizon is really depressed below the real horizon, the sea horizon imaged in a vertical mirror ought to be below the imaged eye-pupils; yet apparently it was not below. It looked as if there could be no depression and that the earth's surface must be flat. But they knew right well (many of them were old sea-captains) that the earth's surface is not flat. To one or two, only one solution of the difficulty—to wit, punching Parallax's head—presented itself. Yet this would not have satisfied the company.

It is easy, however, to see how the difficulty arose, and to devise a way by which a vertical mirror may be made to prove instead of disproving the rotundity of the earth.

Let us see what is the actual depression of the sea horizon, viewed from a goodly height, such as 200 feet.

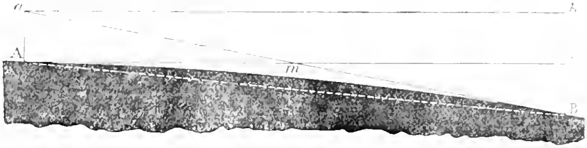


Fig. 8.

Let a (Fig. 8) be the place of the observer's eye, A a being 200 ft.; A B the sea surface; a B the direction of the line of sight from a to the curved sea surface; B b' b vertical at B, and $a\,b$ the direction of the real horizon. Draw A b' parallel to $a\,b$ to meet B b in b'. Then obviously B b' = A a = $b\,b'$ (since B b is appreciably parallel to A a. Therefore B b = 2 A a = 400 ft. Hence the dip of the horizon, or the angle B $a\,b$ is that subtended by 400 ft. at the distance a B or A m B (appreciably the same). Now (Euclid, Bk. III.) the square on a B is equal to the rectangle under A a and the earth's diameter. Hence with feet for our unit of length

$$a\text{B} = \sqrt{7920 \times 1760 \times 3 \times 200}$$
$$= 91450 \text{ ft. approximately } (= 17\tfrac{1}{3} \text{ miles}).$$

Now 400 ft. at a distance of 91450 ft. subtend the same angle as 1 ft. at a distance of about 228 ft., or about one-fourth of a degree. This is very different as anyone can see by looking at a circular protractor and noticing how small are the half degrees usually marked in, from the enormous depression usually indicated in pictures supposed to illustrate the globular shape of the earth. The real angular dip of the horizon is only three-fourths even of this, atmospheric refraction diminishing the true or geometrical dip by one-fourth. The real angle of dip is that subtended by 1 (foot or inch or tenth of an inch) at a distance of about 300 (feet or inches or tenths of an inch).

In Parallax's experiment, supposing the eye one foot from the mirror or two feet virtually from the imaged eye, the imaged horizon (if the station were 200 feet above the sea level, would be $\frac{1}{150}$th of a foot or about 4-hundredths of an inch above the imaged eye-level. This would not be discernible by ordinary eyesight, the line of the imaged sea horizon being intercepted by the imaged head. But I shall now show how this difficulty can be removed, and a pretty illustration of the earth's rotundity be obtained by the mirror method.

Let A B C D (Fig. 9) be a rectangular mirror, broad enough to include the imaged face (the breadth of which is always exactly half the breadth of the real face), and to show an inch or two clear on either side, as shown. Let a line $a\,b$ be drawn with a fine diamond exactly parallel to the sides A B D C. Let the mirror be supported at E and F by rods E G, and F H, which can be fixed into the ground pretty firmly. Let the observer so fix them into a turf sward some 200 feet (say) above the sea level, on a spot commanding a fine sea horizon, putting the face of the mirror seawards. Suppose that at K there is a fine thread K k bearing a plumb-bob P, by means of which the face of the mirror may be made perfectly vertical by suitably turning it on the pivots E F. But as the glass of the mirror may not be of perfectly equal thickness throughout, let the plumb-line admit of being fastened at L, the side D C being made uppermost either by changing the supports or by shifting the mirror in the pivot holes E and F.

After setting the mirror exactly vertical, K uppermost, let the observer retire from it to such a distance—say two yards—that he can see with perfect distinctness not only the pupils of his eyes in the glass, but the diamond line. Let him bring the pupils of his eyes centrally on the line $a\,b$. He will then see that the water surface $c\,d$ is about a quarter of an inch below $a\,b$. On the other hand if by slightly lowering his head he brings the water surface to exact coincidence with the diamond line, he will see that the pupils of his eyes are about a quarter of an inch above

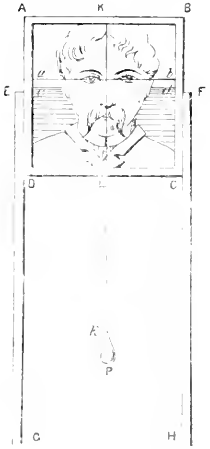


Fig. 9.

that line. Inverting the mirror and letting the plumb-line hang from L, he will get the same result precisely if the mirror is a good one, and very nearly the same result if the mirror is a bad one.

By using a brightly polished plane of steel, which need not be more than four or five inches square, a better result still will be obtained.

But a polished plane of steel four or five inches long and only an inch broad or even less, may be very effectively used without a plumb-line, as follows:—

Fig. 10.

Let A B C D (Fig. 10) be the polished steel plane, set on the edge of a saucer E F, containing a little mercury (or ink). Suppose the cup set on a little platform, admitting of

adjustment by a slow screw movement; and having set A B across the cup, and levelled the cup's surface in direction A B (nothing very exact is needed in this direction), slowly shift the surface in direction square to A B by means of the screw movement, until looking down the face A C its image on the mercury is reduced to a straight line. Then the face A B is perfectly vertical. Now, as before look into the steel mirror A C, bringing the centres of the pupils to the edge A B, as at a, b. The sea horizon will then be seen as at $c\,d$ about a quarter of an inch below A B, if the eyes be about two yards from the mirror.

For different heights, different depressions of the sea horizon will be noted in this experiment. For places near the sea level there is no observable displacement of ef below $a\,b$; for places much higher than the 200 ft. of our experiment the displacement is much greater.

Let us see what is the law connecting h the height of the observer, with the angular depression ∂ of the sea horizon. Call the radius of the earth r. The angle ∂ is the angle $b\,a$ B of Fig. 8, or (appreciably it is the angle subtended by B b, or twice h, at a distance a B. Now

$$(a\,\mathrm{B})^2 = 2rh \text{ (appreciably)}$$

$$\therefore \partial = \frac{\mathrm{B}b}{a\mathrm{B}} = \frac{2h}{\sqrt{2rh}} = \sqrt{\frac{2h}{r}}, \text{ where a right angle} = \frac{\pi}{2} = 1{\cdot}5708$$

Thus the angle of depression varies as the square root of observer's height. In the above, ∂ is the geometrical depression-angle. The apparent depression (which may, indeed, be called the real depression, since it is what is *observed*) that we are inquiring about is about three-fourths the geometrical depression.

Let us inquire what height is required to give an observed depression of one degree, which would be very slight—far too slight to be noticed without the aid of instruments. The above equation gives us, since ∂, the geometrical depression in this case, is four-thirds of a degree.

$$\tfrac{4}{3} \text{ circ. measure of 1 deg.} = \sqrt{\frac{2\,h}{3960}}, \text{ taking a mile as our}$$

unit of length.

$$\text{Now, circular measure of } 1^\circ = \frac{1}{90}(1{\cdot}5708) = {\cdot}01745$$

$$\therefore \text{ squaring, } \frac{16}{9}\,({\cdot}01745)^2 = \frac{2\,h}{3960}$$

$$\text{say (roughly) } 16\,({\cdot}0003045) = \frac{h}{220}$$

$$\begin{aligned} \text{or } h &= 3520 \times {\cdot}0003055 \\ &= 1{\cdot}0754 \text{ of a mile} \\ &= 5678 \text{ feet} \end{aligned}$$

One may say that by ascending to the height of a mile a depression of one degree (apparent) may be observed, if the sea horizon is visible. To attain a depression of two degrees a height of four-and-a-half miles must be attained. This angle would seem very small, scarcely to be recognised by the unaided eye, even if the sea horizon were visible. An ordinary landscape horizon would not seem lowered at all recognisably. Hence the singular optical illusion by which the region visible below a balloon at a great height seems shaped like a vast basin.

(*To be continued.*)

THE AMATEUR ELECTRICIAN.

BATTERIES.—III.

YET one more "typical" cell before we enlarge on some of the many hybrid cells more or less useful to the amateur in his various experiments.

The Leclanché cell, the form of battery upon which it is our present purpose to dwell, is one which is constantly increasing in its sphere of usefulness, and which will doubtless long continue to hold its own against many of the so-called improvements which the recently increased demand for electrical sources have produced. The cell consists of an outer vessel, generally (for convenience only) of glass; inside this is a porous pot, which contains the negative element. The positive element is in the older patterns a circular rod of good but unamalgamated zinc, immersed in a saturated solution of sal ammoniac or ammonic chloride (NH_4Cl or AmCl). The negative element consists of a rod, plate, or block of gas carbon, embedded in a mixture of the same material, crushed to about the size of peas, and similar-sized manganic peroxide or black oxide of manganese (MnO_2). The last-mentioned is one of those substances so bewildering to the tyro, on account of the multiplicity of their names. The mixture, which should nearly fill the porous pot, should contain approximately equal quantities of its constituents and should be free from dust or very small pieces. A piece of paper, or some such substance is then fitted in the pot over the mixture, and pitch marine-glue, or other impervious material poured over it, so as to keep everything in its place, one or two holes, being, however, provided to facilitate the escape of polarising gases. It will be seen that no liquid is placed in the porous pot, the solution for which is provided by a portion of the sal ammoniac solution passing through the pores of the pot. As the function of the carbon rod is simply that of a conductor, it is apparent that its dimensions are immaterial, the chief feature in connection with it being the necessity for providing it with a cap and connections unassailable by ammonia fumes and solution.

When the zinc and carbon connections are joined, chemical action commences, the zinc is dissolved, and converted into chloride of zinc ($ZnCl_2$) by combination with the chlorine of the sal ammoniac. The other portion (NH_4 ammonium) of the sal ammoniac is further decomposed into ammonia (NH_3) and hydrogen. The hydrogen. which is in what is known as the nascent condition, attacks the manganic peroxide, reduces it to a lower oxide (sesquioxide of manganese, Mn_2O_3), and combining with the released oxygen, forms water (OH_2). The series of exchanges may be represented by equation thus:

$$Zn + 2NH_4Cl + 2MnO_2 = ZnCl_2 + 2NH_3 + OH_2 + Mn_2O_3.$$

Those of our readers who are versed in chemical notation will see that for every volumetric equivalent of zinc dissolved, two equivalents of both the sal ammoniac and the manganic peroxide are decomposed; the solution gradually losing its character and becoming instead a solution of chloride of zinc and ammonia, while the manganic peroxide is gradually reduced to a brownish powder and tends in time to make the mixture in the porous cell muddy and more or less impervious, preventing alike the advent of fresh solution and the exodus of uncombined hydrogen.

It will be seen, on examination, that the Leclanché cell differs very widely from either the Daniell or the Bunsen cell. In the Daniell, it may be remembered, we have the hydrogen from the zinc division attacking sulphate of copper, forming sulphuric acid and copper, the latter being deposited on the negative, or copper, plate, which is there-

fore kept constantly bright and of extreme purity. There being a reservoir of sulphate of copper, the Daniell cell remains constant for weeks. The Bunsen cell lasts but a few hours, the liquid surrounding the carbon, or negative, plate, being rapidly weakened and the plate polarised. In this case, instead of the reduction of a metallic salt by the operation of nascent hydrogen, we get the reduction of a most powerful acid, accompanied by the evolution of highly-irritating fumes. In the Leclanché, the sulphate of copper peculiar to the Daniell, and the nitric acid of the Bunsen, are replaced by a dense black solid, viz., the manganic peroxide. While, therefore, the Leclanché is, in the strict sense of the term, a single-fluid cell, there are, nevertheless, two compounds employed, one for the absorption of the zinc, the other for the absorption of the hydrogen.

The continuous action of the cell is, in consequence of the comparatively weak affinity between the hydrogen and the manganic peroxide, of extremely short duration. It cannot be relied upon for more than a few minutes at a time, and is, therefore, useless where anything approaching the character of a permanent current is required. It, however, soon recovers itself, or, in other words, becomes depolarised.

To make a Leclanché cell (which shall be able to ring a trembling alarm bell through such a length of wire as will reach from the basement to the top story of an ordinary house) the outer cell, which may be of any convenient material, should be of about one quart capacity. It is manifestly not essential that a square glass jar such as we are accustomed to see in the Leclanché cell should be adopted. The zinc may be a piece of half-inch rod—or, better still, a cylinder made from thin sheet zinc. An eighth of an inch would be more than ample thickness, and would help to give a current of increased duration, besides considerably reducing the resistance of the cell. As there is no acid in the cell, and as there is no chemical action going on when the cell is not giving a current, there is no necessity to amalgamate the zinc. The connection should be made by soldering a piece of copper wire or strap on to the zinc, and carefully covering the joint and the wire (except the remote end of it) with some pitchy substance to protect them against the ammoniacal vapours which are evolved as the solution gets saturated. Crushed carbon may be obtained at 2d. per lb., and manganic-peroxide at 3d. The carbon rod will cost a few pence, and will then require to be carefully capped. This is done by first dipping the heated top of the rod in melted paraffin wax, and, after allowing an inch or so of the rod to become saturated, melting on (with the aid of a mould) a lead cap. A brass binding-screw of a compact form should be so placed into the mould as to be fastened into the cap. The cap and exposed parts of the terminal then require to be painted with pitch. These rods, already capped, may, however, be purchased in some places for something less than a shilling. The crystallized sal ammoniac costs 9d. per lb.

Where the Leclanché is only required for a few minutes daily it will last for months without any further attention than the addition of a little water.

The electro-motive force of the cell is 1·5 to 1·6 volts. The resistance varies, of course, with the size, but it is very low, the one above detailed being about 2 ohms.

The peculiar traits of the Leclanché cell preclude its adoption for permanent current working, although modifications of it, to be hereafter described, are being used very extensively in the British telegraph service. Its great forte is its ability to supply powerful intermittent currents at a comparatively insignificant cost. Of the little attention it requires we have already spoken.

As we have now reached the length of our tether, we must defer a few more remarks on this highly interesting cell till another opportunity presents itself.

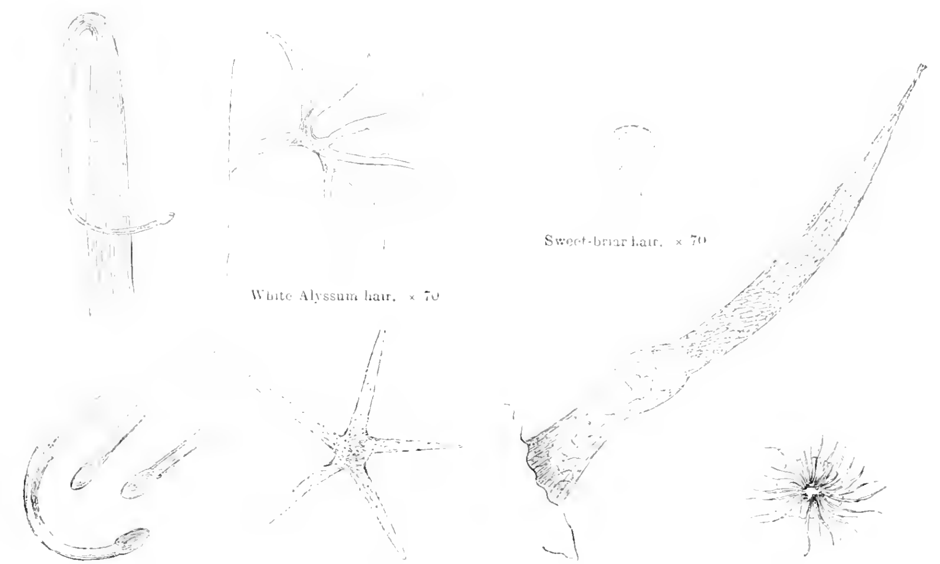
PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.C.S., F.R.M.S.

One great advantage of the microscope arises from the facility with which it can illustrate many of the most important principles of scientific investigation. Let us consider, for example, the hairs of plants. First comes the inquiry, What is a plant hair? The popular answer might be, "Anything hair-like that grows from a plant;" but this would not suffice, as many appendages of plants must be grouped with hairs, although they depart widely from the conception of a hair, founded upon the protective and decorative covering of the human head. Take up any hairy leaf or flower-petal, and with a sharp penknife cut some of the hairs off just below their base. It is seen that this may be done by removing a piece of the epidermis, without penetrating into the leaf-substance. Go to a rose-tree, with stout, sharp thorns. Press one of these strongly on one side, and it will break off without injuring the wood of the stem from which it is taken. Next pull a thorn off a small branch of quickset, and some of the wood comes with it. Here, then, is a distinction of importance. Hairs and rose-spines are structures growing out of the epidermis, and in any case all objects ranking as hairs spring "from the layer of cells which always remain outermost in roots, stems, and leaves, whether these outgrowths occur as simple utricular (little bladder-like) protuberances, rows of cells, plates of cells, or masses of tissue, or have the physiological character of woolly envelopes of the young leaves, root like absorbing organs (mosses), glands, prickles, or spore capsules (ferns)." So says Sachs, in his "Text-Book of Botany." Amongst animals we have some similar variations from soft, thin hairs, to sheep wool, bristles of hogs, cats' whiskers, porcupines' quills, and rhinoceros' horns. The horn of the rhinoceros, says Owen, "consists of a uniform compact mass of epidermal fibres," that is hairs, and much the same may be said of rose-spines. The thorns of May-trees, &c., belong to the wood, somewhat as the horns of deer "consist wholly of bone" (Owen).

There are two different scientific ways of studying the parts or organs of plants and animals—one, the morphological, which investigates how they grow, and from what parent formation; and the other, the physiological, which looks into the functions they perform, or the services they render. It is very often found that parts which are morphologically similar, have quite different uses. Thus, hairs of plants, which protect a young bud or leaf surface, are not like rose-spines, nor in their function the same. Plant hairs which are glandular, and secrete a particular fluid, are different in function from others which oppose a mechanical obstacle to the entrance or exit of certain insects, and thus act as aids to the process of fertilisation. Similar illustrations of similarity of origin and great difference of function abound in the animal world, and as a familiar example, we find the morphologist regarding the biting jaws of the spider as modified feelers (antennæ), and the nipping claws of scorpions as modified maxillary palpi.

Plant hairs of all sorts recognised by the morphologist are technically called *trichomes*, which means hair-sort of things in origin and structure, whatever may be their use or shape. The simplest hairs are unicellular; other hairs



White Alyssum hair, × 70. Sweet-briar hair, × 70.

Drosera rotundifolia, × 30. Deutzia scabra, × 70. Stinging-nettle hair, × 70. Heritiera minor, × 120.

may have many cells at their base and cellular divisions in the upper part. Round the edge of a sweet-briar leaf are short, stumpy tubes ending in a pretty ruby-coloured gland. Similar hairs, but less brightly-coloured at their tips, are abundant on the under surface of the leaf, and all are glandular, secreting the sweet scent. Extremely beautiful hairs of this type, but longer, decorate the stems of London pride. They form very striking objects when brilliantly lit up and magnified about fifty times. The elegant pink heath (*Erica tetralix*) is similarly ornamented. Glandular hairs may absorb as well as secrete. The remarkable hairs of the Drosera and of other insectivorous plants are illustrations; but the character of Drosera hairs entitles them to be called tentacles. They have a good deal of true leaf structure in them, and the glandular tips are composed of complicated groups of cells. Botanists reckon them amongst the trichomes, but their whole structure shows how close they are to expansions of the leaf, and not, like the simplest hairs, mere outgrowths of epidermis. They are prey-capturing and digesting organs, much like the tentacles of anemones. The short hairs in the middle of the Drosera leaf can convey impressions to the marginal hairs, causing them to close and hold fast the prey which is attracted and caught in the secretion, which gives the popular and pretty name of Sun Dew to the plant. "If an insect adheres to only a few of the glands of the exterior tentacles, these soon become inflected, and carry their prey to the tentacles next succeeding them inwards; these then bend inwards, and so onwards until the insect is ultimately carried by a curious sort of rolling movement to the centre of the leaf" (Darwin). Experimenting with other leaves, Darwin found the glandular hairs on those of two kinds of saxifrage, of a primula, and a pelargonium would rapidly absorb weak solutions of carbonate of ammonia and weak infusions of raw meat. The glands of an erica, a mirabilis, and a nicotiana did not exhibit such a power. With reference to the above observations, Darwin remarked* :—"The glandular hairs of ordinary plants have generally been considered by physiologists to serve only as secreting organs; but we now know that they have the power, at least in some cases, of absorbing both a solution and the vapour of ammonia. As rain-water contains a small percentage of ammonia, and the atmosphere a minute portion of the carbonate, their power can hardly fail to be beneficial, nor can the benefit be quite so insignificant as it might first be thought, for a moderately fine plant of *Primula sinensis* bears the astonishing number of about two millions and a-half of glandular hairs, all of which are able to absorb ammonia brought to them by the rain."

The hairs that form the pappus of thistles and allied plants are sometimes simple, and of others feathered, as in the Carline thistle. On the anther filament of spiderwort (*Tradiscantia Virginica*) the hairs are like chaplets of beads, and each bead shows the cell rotation of the sap, if put in a drop of water, covered, without squeezing, by thin glass, and magnified three or four hundred times. All hairs of plants and trees are said to exhibit this sap movement at some period of their lives

A shrub, common in gardens, *Deutzia Scabra*, has an immense number of star-shaped hairs on its leaves, chiefly on the upper surface. These are thickened with an exquisite deposit of silex, and are fine objects under the polariscope and a magnification of from fifty to one hundred times.

The rays of the larger Deutzia stars are usually four or five: besides these there are multitudes of smaller stars with many more rays. Similar stellate hairs, but not so big, occur on the smaller-leaved *Deutzia gracilis*.

Many plants have multiple-rayed stars on their leaves. One of them, *Heritiera minor*, a tree found on the coasts of India and Africa, and cultivated in the West Indies, has

* "Insectivorous Plants," pp. 354-5.

the under-side of its leaves so white and shiny, as to be called the Looking-glass Tree. This appearance is caused by sun-rayed hairs, of which a sketch is given.

Sketches are given of various hairs, with their names and magnification employed, drawn from the objects by Mrs. H. Slack.

THE SHOEBILL.

THE Shoebill (*Balæniceps rex*), a singular African bird, is a representative of the family Balænicipidæ. It has a thick neck and large head, and a huge bill, which from its resemblance in size and shape to a shoe has gained for it the title of shoebill.

Wood says: "The bill is enormously expanded at each side of the beak, the edges of the upper mandible overhang those of the lower, and its tip is furnished with a large hook, which is well suited for tearing to pieces the substances on which the bird feeds." It has very long legs and large feet whose long toes are provided with powerful nails, broad and long wings, and a short tuft of feathers at the back of the head.

The general colour of the plumage is a beautiful ash-grey; the edges of the large feathers are bordered with light grey. The eye is bright yellow, the bill horn colour, the foot black.

Young birds are a rusty, brownish grey. The length of the male bird is a hundred and forty centimètres. The female is considerably smaller. These giant birds of the morass, according to the observations of Heuchlin and Schweinfurth, live by pairs or in scattered companies—as far as possible distant from all human settlements, in the huge, almost impenetrable morasses of the White Nile and some of its tributaries, between the fifth and eighth degrees of north latitude. It has not been observed around the other waters of inner Africa. Usually this bird is seen standing fishing in the pools, in the midst of these swamps. It is very shy and cautious, and at the approach of man it rises with a loud rustling noise, and flies low over the reeds, which soon hide it from sight.

If it becomes frightened by the report of a gun, it rises high in the air, circles and hovers around for a long time, and will not return to the water as long as it suspects the presence of man. It is seldom seen on the banks of rivers. When walking it carries its body in a horizontal position, and rests its heavy head on its crop. When flying it draws in its neck. It makes a loud, rattling, cracking sound with its bill, which puts one in mind of the clatter of the storks. Its nourishment consists principally of fish, and it is often seen standing up to its breast in water, and thrusting its powerful bill suddenly under the water, in the same manner as herons do, in order to capture the fish. Petherick asserts that the Shoebill catches and eats water-snakes, and that it also feeds on the intestines of dead animals, the carcasses of which it easily rips open with the strong hook of its upper bill.

Their breeding-time is in the rainy season, during the months of July and August, and the spot chosen for their nest is in the reeds immediately on the water's edge, or on some small, elevated, dry spot entirely surrounded by water. It builds from the dry stalks of the swamp, plants, sod, and mud, a very firm nest often a yard in height. Heuchlin says the eggs are comparatively small, about three inches long and two inches thick; the shell is finely granulated. —*From Brehm's "Animal Life."*

THE MORALITY OF HAPPINESS.

By Thomas Foster.

(*Continued from page* 67.)

THE EVOLUTION OF CONDUCT.

AS structures are evolved, so are the functions which structures subserve. And as the functions of the body are evolved so are those combinations of bodily actions evolved which we include under the general term conduct.

We are considering the functions of the body when we are inquiring into such actions of the various structures internal and external as involve internal processes, simple or complex. But when we begin to consider combinations of actions externally manifested we are dealing with *conduct*,—except only in the case of such actions as are independent of control.

But at the outset of the evolution of conduct even this distinction is scarcely to be recognised. Every external combination of actions is in the lower types of animal life a part of conduct,—at least of such conduct as is possible in the lowest orders of creatures. Evolution of conduct begins with the gradual development of purpose where

at first actions were random and aimless. The *Amœba* wanders from place to place, not by the action of limbs but by a process which may be called diffluence. In so doing it may come into the neighbourhood of objects fit to form its food; these it enwraps, and absorbing what is digestible rejects the rest. Or its wanderings may lead it into the way of some creature by which it is itself absorbed and digested. There may be some higher law than chance guiding the movements of such creatures; but so far as can be judged this is not the case. In other words there is but the suspicion of something like *conduct* in the actions of the Amœba. Among other creatures belonging to the same kingdom, but higher in type, we find actions so much better adjusted, that though even yet we cannot recognise such evidence of purpose as enables us to describe their actions as conduct, we yet see in their adjustment to certain ends the development of something akin to conduct. The actions seem guided by what mimics purpose if it is not purpose itself.

Now we note that with the improved adjustment of actions comes an increase in the average duration of life, or rather in the proportion of this average to the length of life possible among these several creatures.

So when we pass to higher and higher orders of animals, we find in every case among the lower types irregular and seemingly purposeless actions, while among the higher we find actions better adjusted to the surroundings. And again we note that where the combination of actions, or what we may now call the conduct, is not adjusted to the environment, the creatures' chances of life are small, great numbers dying for each whose life approaches the average duration. An improved adjustment of conduct to environment increases the chances of survival, many attaining and some passing the average of longevity in their particular type or order.

Now structural development is guided by the fitness or unfitness of particular proportions in such and such structures for the great life struggle in which all animal life is constantly engaged; and functional development is guided by the corresponding fitness or unfitness of such and such functional activities. Just as certainly the development of conduct in all orders of living creatures is guided by the fitness or unfitness of such and such combinations of external actions for the constant life-contest.

We might find illustrations of this in every kingdom, sub-kingdom, order, and type, of animal life. Let us, however, content ourselves by noting it in man.

In the lower races of man as at present existing, and in still greater degree among the lower races when the human race as a whole was lower, we see that the adjustments of external actions to obtain food, to provide shelter against animate and inanimate enemies, and otherwise to support or to defend life, are imperfect and irregular. The savage of the lowest type is constantly exposed to the risk of losing his life either through hunger or cold, or through storm, or from attacks against which he has not made adequate provision. He neither foresees nor remembers, and his conduct is correspondingly aimless and irregular. The least provident or rather the most improvident perish in greatest numbers. Hence there is an evolution of conduct from irregularity and aimlessness by slow degrees towards the regularity and adaptation of aims to ends, seen in advancing civilisation. The ill-adjusted conduct which diminishes the chances of life dies out in the struggle for life, to make way for the better-adjusted conduct by which the chances of life are increased. The process is as certain in its action as the process of structural evolution. In either process we see multitudinous individual exceptions. Luck plays its part in individual cases; but inexorable law claims its customary rule over averages. In the long run conduct best adapted and adjusted to environment is developed at the expense of conduct less suitable to the surroundings.

With man, as with all orders of animals, conduct which tends to increase the duration of life prevails over conduct having an opposite tendency. Wherefore, remembering the ever-varying conditions under which life is passed, the evolution of conduct means not only the development of well-adjusted actions, but the elaboration of conduct to correspond with those diverse and multitudinous conditions.

To these considerations we may add that the evolution of conduct not only tends necessarily to increased length of life (necessarily, because shortening of life means the diminution of such conduct as tends to shorten life), but it results in increased breadth of life, and (in the highest animal) in increased depth of life also. It is manifest that in the elaboration of activities by which length of life is increased, breadth of life is increased *pari passu*. For these activities may be said to constitute breadth of life. Passing over the numerous illustrations which might be drawn from the lower orders of animal life, we recognise in man a vast increase in the breadth of life as we pass from the limited orders of activity constituting the life of the savage to the multiplied and complex activities involved in civilised life. Increased depth of life we recognise only (but we recognise it clearly) in the most advanced races of that animal which not only thinks and reasons but reflects.

We find then that the evolution of conduct is not only accompanied by increased fulness of life, but is to be estimated by such increase. We do not say that that conduct is good in relation to the individual which increases and that conduct bad which diminishes the fulness of individual life in the individual. We assert, for the present, only what observation shows,—that conduct of the former kind is favoured (other things equal), and therefore developed, in the life struggle, while conduct of the latter sort tends to disappear as evolution proceeds.

Thus far we have only considered conduct in relation to individual life. We have still to consider the evolution of conduct as related to the life of the species.

(To be continued.)

LAWS OF BRIGHTNESS.

VIII.

By Richard A. Proctor.

I HAVE hitherto said nothing about the absorption of light, although it obviously affects the brightness of objects. The fact is that in considering the celestial objects we are more directly concerned with the absolute intrinsic lustre of their surfaces, whether that lustre be inherent or imparted. The absorption exercised by our own atmosphere of course affects their apparent brightness; but as a rule we compare their lustre under similar circumstances, selecting also those epochs when, owing to their considerable elevation, the absorptive effects of our atmosphere are as small as possible. And as respects absorptive effects exerted by the atmospheres of the planets themselves we need not specially concern ourselves, because it is, in point of fact, to a certain extent self-compensatory. If a planet possesses an atmosphere so rare and pure that nearly all the light falling upon it passes into and through it to the planet's surface, then, although a greater proportion of the received light is thus exposed to the

absorptive action of the atmospheric medium, yet on the other hand the planet's surface is so much the more brightly illuminated, and the light so illuminating it passes so much the more readily on its return journey through the planet's atmosphere. On the other hand, if a planet's atmosphere is dense, although such an atmosphere much more completely absorbs the light which enters it, yet, on the other hand, it resists the entrance (so to speak) of a much greater proportion, and moreover it is itself illuminated by that which it absorbs. The compensation thus effected may not be, and probably is not complete; but we are precluded (at least until we have much more exact information than has yet been obtained) from discussing satisfactorily the effects due to absorption by the planet's atmospheres. A similar remark applies to the difference between the absorptive effects of a planet's atmosphere near the centre and near the edge of the disc. At the centre more light passes through the atmosphere, and so the planet's surface is more brilliantly illuminated (apart from the consideration of the angle of incidence). At the edge the light has a longer course through the atmosphere, and is therefore much more freely absorbed, so that the planet's surface is much less fully illuminated than it would be if there were no atmosphere. Nevertheless, there is no corresponding falling off in the apparent brilliancy near the edge, for the atmosphere is itself illuminated. Whether this illumination will be greater or less than that which would result if there were no atmosphere, will depend on the nature, extent, and condition of the atmosphere.

Passing from such considerations as these, which are of too difficult and complicated a nature to be here satisfactorily discussed, let us consider how far our estimates of relative brightness are to be depended upon. It must be remembered that in all observations we have to deal with the experience of the senses, and that the senses are fallible. It is important that we should know to what extent the senses *are* fallible in this particular matter of the estimation of light.

Unfortunately, we find the result of such an inquiry not altogether encouraging. There is, perhaps, no subject of research in which the senses are more apt to be deceived than they are in dealing with different degrees of luminosity.

For instance, I have often been asked if it is possible to believe that the faint light of "the old moon in the new moon's arms" is equal to that due to full moonlight; still less, it is urged, can it be equal to that due to full earthlight. Yet the darker part of the moon's disc at the time of new moon is illuminated by full, or nearly full, earthlight. Hence, some imagine that distance must reduce the apparent brilliancy of the light received from that portion of the moon. Of course I do not refer to this mistake for the sake of refuting it, but it affords an excellent illustration of the way in which the senses may be deceived. Let any person look at a distant hill bathed in full moonlight, note carefully its apparent brilliancy, and endeavour to retain the remembrance of it. Sixteen or seventeen days or so afterwards let him observe the young moon, and note the faint light of the part which is not in sunlight, and compare that light with the light of the moon-illumined hill he had formerly observed. It will appear manifest, and so far as the sense of sight is concerned it is manifest, that the light of the hill is far the brighter. Nevertheless, nothing can be more certain than that the light of the old moon is ten or twelve times as bright. The explanation is simple. When we are looking at the new moon, we see the light of the crescent which is illuminated by the sun, and the light of the rest of the disc which is illuminated by the earth. Sunlight exceeds full moonlight some 618,000 times, and it exceeds full earthlight some 50,000 times. It is clear that in the presence of a degree of brightness 50,000 times greater, the brightness of the earth-lit part of the moon must appear by contrast altogether insignificant.

Then, again, we are apt to forget when we are looking at a moonlit landscape, that the brightness of the scene depends largely on the quantity of light, not on its intrinsic brilliancy. Let a small round hole be pierced at the end of a blackened case; let the observer be so covered that he can see only through that hole; and let the hole be so placed as to correspond exactly in seeming magnitude with the full moon: then, if the observer look through that hole at a moonlit hill, he will at once see how utterly insignificant moonlight is by comparison with sunlight. And yet even then the comparison is made under circumstances altogether favourable to the moonlight. For under the darkness in which the observer is enwrapped, the pupil of the eye dilates, and a much larger proportion of light is thus received than would be the case if no such change took place. But let the experiment be renewed at the time of new moon, and in such a way that only the light from the earth-illumined part of the disc is in the field of view; then will the relative superiority of earthlight over moonlight be clearly recognised.

I do not speak at random. I have tried these experiments.

It would be easy to cite multitudes of similar instances. But let us pass from the consideration of eye-estimations of different degrees of light at different times, to consider how far the eye is competent to compare different degrees of lustre observable at the same time.

It is very commonly stated, though not constantly, that the planet Jupiter shows brighter at the edge all around the disc, than in the middle. Certain observations of the satellites serve to show that the reverse is really the case. Noticing a passage in an excellent paper by Mr. Browning on the planet Jupiter, in which the former view was stated, I expressed doubts on the point. "But," said Mr. Browning, "I do not repeat anything I have heard or read on this matter, I describe what I have seen." Knowing that to prove himself mistaken would be quite as pleasant to him as to prove himself in the right, I asked him to take an early opportunity of testing the matter by the use of a carefully-graduated darkening glass. He did so, and found that though Jupiter (when in opposition,—near quadrature there is a difference) *looks* distinctly brighter near the edge than in the middle, he *is* distinctly brighter in the middle than near the edge. The deception is due, no doubt, to the contrast between the edge and the dark sky.

I have very little doubt that the apparent brightness of the moon's edge when she is full is to *some* degree an effect of contrast; though it remains recognisable when the test of the graduated glass is applied.

And here another question suggests itself. What is the effect of either intensifying or reducing in the same degree all the lights of a surface variously illuminated? Intensifying is not easy; since there is absolutely no device by which any surface can be made to look brighter than it is.* Nevertheless, as we sometimes see surfaces less bright than they really are, we may by removing the cause which had diminished the light intensify the apparent brightness. For instance, by travelling south, and getting to the summit of a high mountain, an Englishman can gain

* I am referring to celestial objects chiefly. We may, of course, illuminate a surface more or less brightly; but extraneous light causes perplexity in nearly all experiments on the illumination of terrestrial surfaces.

views of the moon near the zenith considerably brighter than those he can obtain in his own country.

However, the effects of darkening being more readily tested, I select them to consider here.

When we use a very deep darkening glass in the study of the sun, for example, do we leave the relative degrees of brightness unchanged? We may or we may not. The matter is one for experimental research, and such research would be by no means easy. But one thing is certain. We reduce the lower lights in such cases to what appears *to the sense of sight* as absolute blackness—*zero* in our light scale—and we leave the brighter parts with a degree of light which is not zero, but a finite quantity. Now, since the smallest finite quantity exceeds zero in an infinite degree, we clearly have affected the apparent proportion between the brighter and darker parts of the sun in such sort that it no longer corresponds to the true proportion; for assuredly the light of the brighter parts of the sun does not infinitely exceed that of the darker portions.

Thus it is seen that in this instance, at least, we cannot safely assume that the relative brightness of surfaces variously illuminated, is left unchanged by a common darkening which theoretically should affect each in the same proportion.

I think this will be enough to show how important it is in all questions relating to brightness to consider the possible action of physiological causes. We ought to multiply our tests in order to evade deception, and not be too sure even then that we may not remain to some degree deceived by our senses.

(*To be continued.*)

THE DEATH OF CAPTAIN WEBB.

THE *New York Times* gives some particulars of the finding of Captain Webb's body. A correspondent at Niagara Falls states that about ten o'clock on the morning of July 28 a stonemason named Turner was crossing the river in a small boat, about one and a half mile north or down stream from Lewistown, when he discovered the body floating face down, only a few rods out from the American shore, floating down with the current. He took it to Lewiston, where it was identified a few hours afterwards. The cloth was still around the loins, and the body appeared to have suffered little from the rude force of the water. It was found a little less than four days after it entered the Whirlpool, which is a remarkable fact, as bodies passing into the dreadful vortex often remain there a whole week before being discharged into the Rapids below. A striking illustration of the shifting nature of the currents of the Niagara River above and at Lewiston has occurred contemporaneously with the melancholy case of Captain Webb. On Monday, July 23, rather more than twenty-four hours before Captain Webb dived from McCloy's boat above the Suspension Bridge, a number of Indians clambered up the rough and precipitous bank on the American side to a point called the "Rocks" above Lewiston, and about midway between that place and the Suspension Bridge.* The river there is a narrow and foaming torrent, though less frightful than the Whirlpool Rapids. Yet it is in the few yards of swift, unbroken water next the shore at this point that the Indians have long been accustomed to bathe, and it is their favourite place for learning (*sic*) their boys to swim. Two of them, while bathing, ventured a little too far out, were caught by the roaring torrent, and hurried down the river like two corks. Their companions witnessed their fate, but were of course helpless to aid them. The bodies must have been detained by the deep-water eddies above Lewiston for five days. Within an hour of the time of the finding of Captain Webb's body the bodies of these two Indians were found at a spot only two miles from the place where they entered the water. On July 31, an inquest was held on the remains of Captain Webb. On the previous day Mrs. Webb, in company with her late husband's manager, Mr. Kyle, arrived at Niagara Falls from Boston. On viewing the Rapids, she said she believed her husband could swim safely through them, and that he was killed by striking the rocks. Mrs. Webb and Kyle identified the body, and Dr. Palmer, of Lockport, who made the *post-mortem* examination, testified that he thought the reactionary force of the water had paralysed the nerve centres, and rendered breathing impossible.—The jury found a verdict that Captain Webb came to his death while attempting to swim the Whirlpool Rapids, but that they were unable to determine the immediate cause of death.

* See Map of the Niagara Falls and Rapids, p. 72.

THE Glasgow *Weekly Mail* says:—"It is understood that the Town Council have resolved to raise an action in the Court of Session to compel the North British Railway Company to remove the ruins and *débris* of the old Tay Bridge before proceeding with the erection of the new one. The Council, in taking this step, are believed to be proceeding upon the opinion of eminent Parliamentary and Scotch counsel as to their rights under the last Tay Bridge Act. The clause relating to the subject definitely states that the company are bound to remove the ruins and *débris* of the old Tay Bridge, and that the Town Council may force them by legal action to do this, but no time is stated within which the work shall be done."

THE soap-bubble colours upon glass are produced by a vapour, which is deposited on the hot glass before it goes into the annealing oven. According to the *Bulletin de la Société d'Encouragement* the vapour comes from a mixture of protochloride of tin, carbonate of baryta, and carbonate of strontia. It is said that the workmen of a Bohemian manufacturer, wishing to celebrate his arrival, kindled some Bengal lights in the annealing furnaces, and the pieces which were in the furnaces all became iridescent. The colours can be removed by hard rubbing. Messrs. Clémandot and Fremy produced a pearly lustre, like that of shells, by means of different chemical agents, chlorhydric acid among others, under pressure of four, five, or six atmospheres.

THE *Engineer* notes that an important meeting of the directors of the principal steamship insurance companies in the North of England was held last week at Newcastle, to take into consideration the report of a sub-committee which was recently appointed to investigate sundry allegations of unfair dealing by some of the shipowners in that district. These gentlemen, it appears, have been in the habit of receiving large discounts off their repairing accounts without placing them to the credit of the insurance companies, who in this manner have, in the single case under consideration, been bled to the extent of several thousand pounds. It is stated that the shipowners offered a sum of no less than £10,000 to settle the matter. This, however, has not been accepted, and at the meeting it was unanimously agreed that the steamers belonging to the firm in question should not be insured any longer in the various societies which were there represented. We understand that several other cases of a similar character are now under investigation, while strict inquiries are being made in certain quarters where dealings of the same kind are suspected.

THE FACE OF THE SKY.

FROM AUGUST 17 TO AUGUST 31.

BY F.R.A.S.

THE recent exhibition of increased activity on the surface of the sun will, of course, prompt the student to keep a sedulous watch upon the solar disc for its consequent phenomena. Such a spectacle as that described by Mr. Slack (p. 70) will afford an ample reward for any amount of watching. The night sky will be found delineated on Map VIII. of "The Stars in their Seasons." Mercury is but indifferently placed for the observer, but may just possibly be caught on a very clear evening after sunset, close to the horizon and a little to the south of west. Venus remains, for our present purpose, invisible; as do Uranus and Neptune. Mars rises before midnight, almost in the north-east. His telescopic diameter is too small to enable the observer to examine his surface. He still presents the appearance of a blazing red star, and is situated to the north-east of ζ Tauri ("The Stars in their Seasons," Map I.). Jupiter has not yet come into sight. Saturn rises, of course, sooner and sooner every night, appearing above the north-east by east point of the horizon about 10 p.m. at the end of August. Hence, by midnight, he will be some 18° high, and fairly well observable. He is moving slowly to the eastward in that void part of the sky north-east of ε Geminorum (Map I.). The moon is 14·4 days old at noon to-day, and, quite obviously, 28·1 days old at the same hour on the 31st. Hence, after about the 25th she will be but poorly placed for the observer during the working hours of the night. Two occultations of stars will occur during the fourteen days covered by these notes. The first will happen on the 21st, when the 4th magnitude star ε Piscium will disappear at the moon's bright limb at 12 h. 20 m. p.m. at an angle from her vertex of 155°, and reappear from behind her dark limb at 12 h. 42 m. p.m. at an angle of 197° from her vertex. The second occultation will be that of the 6th magnitude star B. A. C. 1206, which, on the night of the 24th, will disappear at the moon's bright limb at 10 h. 30 m. at an angle of 73° from her vertex; re-appearing at her dark limb at a vertical angle of 235° at 11 h. 21 m. p.m. During the whole of to-day and to-morrow, and, in fact, until 6 p.m. on Sunday, the 19th, the moon will be travelling through Aquarius, from which constellation, at the hour named, she will pass into Pisces. She will not quit Pisces until 9 p.m. on the 22nd, when she will travel into Aries. She will occupy until 1 p.m. on the 24th in crossing Aries, and will enter Taurus between 1 and 2 o'clock on the afternoon of the latter day. She continues in Taurus until 1 a.m. on the 27th, when she begins to cross the northern part of Orion. This occupies her until 2 p.m. on the same day. She then emerges in Gemini, and remains in that constellation until 7 a.m. on the 28th, at which hour she enters Cancer. It will be 11 o'clock at night on the 30th before she reaches Leo. There she continues until 10 p.m. on the 31st, when she descends into Sextans. We there leave her.

IN 1871 the total population of the seven Australasian colonies—which include the five Australian colonies, viz., Victoria, New South Wales, Queensland, South Australia, aud West Australia, and the colonies of Tasmania and New Zealand—was only 1,978,740. In 1881 the total population was 2,835,954, showing an increase in ten years of 857,206, or an average of 85·7 per cent. Ten years ago the combined exports of the same colonies amounted to approximately £67,000,000, and in 1881 to £105,000,000, showing an advance of more than 50 per cent. This is equal to about £38 per head of population. The public revenue of the seven colonies during the year 1881 amounted to about £21,000,000, against £18,000,000 in 1880, being an increase of £3,000,000. The colonies possess 5,426 miles of railway, 49,105 miles of telegraph, 78,000,000 sheep—the wool clip of which last year realised the sum of about £21,000,000—besides 8,691,910 cattle, and several millions of horses and pigs. During the year 1881, 16,690 vessels, of an aggregate tonnage of 9,501,130, touched at the various ports of the colonies. The same colonies have 7,017,380 acres of land under profitable cultivation, and produce annually about 30,000,000 bushels of wheat, and 11,717,819 bushels of oats. Of these latter New Zealand alone produces 6,924,818 bushels.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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PRESCRIBING FOR CHOLERA.

[896]—With reference to the letter appearing on page 60 of KNOWLEDGE, July 27, 1883, headed "Cholera" (preventive), I wish to make a few remarks.

In the first place, the reverend gentleman should have defined cholera as he understands it and prescribes for it. Judging by the tenour of the letter, he draws no distinction between cholera and diarrhœa in its severer forms. Now, it is hardly necessary to say that a primary essential to correct and rational treatment is to understand what disease has to be dealt with.

Again, filtration of water is not sufficient; it is necessary to boil it and preserve from absorbing impurities present in the atmosphere, which it will do readily on cooling. It cannot be too clearly understood that no prescription is indiscriminately applicable to several cases. In diarrhœa, pre-eminently, the treatment of a given case will depend upon its cause, and the sooner the doctor sees the case the better. It is folly to trifle away time that may be of vital importance. Why the crudely and imperfectly transcribed prescription should be called an "Indian remedy" I cannot imagine—nor can I imagine how an educated man can so lack in ordinary etiquette as to publish the result of other men's labours without attempting to acknowledge whence the information was derived. I take this opportunity to draw attention, through the columns of your journal, to the obvious irregularity of a clergyman taking upon himself to prescribe—unfortunately, of not infrequent occurrence. Surely a very recent example should prove a warning.

A READER.

[We agree with "A Reader," that there is an objection to publishing prescriptions in such organs as KNOWLEDGE, HEALTH, &c., even though such prescriptions may have high medical authority in their favour. The prescriptions may be good but their application may be bad. "Won't do so any more."—R. P.]

GIRTH AND THE PARCEL POST.

[897]—It may bo useful in view of the coming operations of the Parcel Post to inquire minutely into the restrictions which the authorities impose upon the size of the parcels that may be sent. These are—Maximum length, 3 ft. 6 in.; maximum length and girth combined, 6 ft.

The first presents no difficulty. A parcel has of necessity, like any other solid body, length, breadth, and thickness—i.e., it has three dimensions. The above restriction simply requires the greatest dimension to be less than 3 ft. 6 in.

When we come to the second restriction we are met by the word "girth." Now girth is a good old Saxon word, and is connected with girdle. The scientific idea presented to the ordinary feminine mind is "how much round the waist?" unless, indeed, the answer come from a Girt(h)onite, and then something very precise may be expected.

The word girth may be paraphrased circumference or perimeter. The old mathematical term is periphery. Imagine a solid cylindrical pillar of circular section, such as may be seen in many churches and cathedrals. Suppose it were required to calculate the number of cubic feet in such a pillar the height of which was known. A string passed round would give the girth, say 10 ft. Since the circumference of a circle is three and one-seventh times its diameter, this would give the diameter about 3 ft. 2 in. Whence the area of

the circular section and consequently the cubic contents of the pillar could be obtained.

Now, imagine the pillar to become very extensively dwarfed, so as to meet the requirements of the parcel post; its length to be 3 ft. 6 in., and its girth consequently 2 ft. 6 in., so that the two are together 6 ft. Proceeding as before, we should get the diameter of the circular section very nearly 10 in. If, then, we conceive a cylindrical parcel about a yard in length, and each end about the size of a dinner-plate (10 in. in diameter), this will represent the required limits.

When the parcel is shaped like an ordinary box the girth becomes twice the breadth and thickness together; or, if the section be square, four times the edge of one end. The longest box, then, that can be sent is one 3 ft. 6 in. in length, and the edge of whose end is $7\frac{1}{2}$ in.

If the box be of cubical shape the length of its edge must be one-fifth of 6 ft.; or about 1 ft. 2 in.; and this is the greatest-sized cubical box that can be sent.

It may be shown by the differential calculus that the largest content to be got out of the box shape is when the dimensions are 2 ft., 1 ft., 1 ft. or two cubes of 1 ft. placed face to face. For the cylindrical shape this becomes length 2 ft. (as before), and girth 4 ft. giving a circular section of about 15 in. diameter.

R. F. Davis, M.A.,
Cambridge, Queen's College; Member of the London Mathematical Society.

AUDITORY FANS.

[898]—The fans, &c., spoken of in your answers to correspondents under C. Thompson, are sold with all particulars at a shop next door to St. Saviour's Deaf and Dumb Church, 419, Oxford-street. Nox.

THE VORTEX-ATOM THEORY.

[899]—The vortex-atom theory, viewed from the physical side, is regarded by some as one of extreme simplicity. I must confess, however, that to me it appears to be far otherwise. In fact, I am unable to understand how the theory is to be reconciled with the first law of motion. According to that law no body possessing inertia can deviate from the straight line unless forced to do so. A planet will not move round the sun unless it be constantly acted upon by a force deflecting it from the straight path. A grindstone will not rotate on its axis unless its particles are held together by a force preventing them from flying off in a tangent to the curve in which they are moving. Centrifugal force must always be balanced by centripetal force. My difficulty is to understand what force counterbalances the centrifugal force of the rotating material of the vortex-atom. It has been said that the centrifugal tendency of the rotating material of the vortex-atom is controlled by the exterior incompressible liquid. But it is also stated that this incompressible liquid offers no resistance whatever to the passage of the atom through it. In short, that in so far as the motion of the atom is concerned this liquid is a perfect void. Now, if this liquid can offer no resistance to the passage of the atom as a whole, how then does it manage to offer such enormous resistance to the materials composing the atom so as to continually deflect them from the straight path and compel them to move in a curve? The centrifugal force of these vortex-atoms must be enormous, for on it is assumed to depend the hardness or resistance of matter to pressure. Now the centripetal force which balances this centrifugal force must be equally enormous. Then if this perfect fluid outside the vortex-atom can exert this enormous force on the revolving material without being itself possessed of motion, then there does not seem to be any necessity for vortex-motion in order to produce resistance.

It has further been advanced, by way of explanation, that this incompressible liquid surrounds the revolving liquid like a pipe, "and that if the liquid in this pipe were to fly out, a temporary void would be formed in it, which is impossible in a liquid that already occupies all space." The incompressibility of the surrounding fluid surely cannot be a reason why portions of the revolving material do not fly out, for if incompressibility could prevent portions of the revolving atom from flying away, it would equally prevent the whole atom from doing so, but according to hypothesis this incompressible fluid offers no resistance to the motion of the atom. When the atom moves it is assumed that the fluid in front is displaced; but then this simply makes room for an equal quantity behind, and thus no void is formed. The very same thing ought to take place, though only a portion of the atom were to fly off. The various portions of this revolving material are not supposed to be held together by any cohesive force like those of the grindstone. What then prevents the revolving material from being dissipated by the centrifugal force of rotation? In short, how is the existence of the atom possible under the physical conditions assumed in the theory? James Croll.

LETTERS RECEIVED, AND SHORT ANSWERS.

L. A. B.—The small magnets would very speedily have their polarities reversed by the more powerful fixed magnets, and resistance to rotation would ensue. Supposing, however, that the polarities were unaffected, the action would be in character with that which would result if a diamagnetic substance were substituted for the small magnets—that is to say, resistance to motion would evidence itself. It will be seen that although repulsion would be exerted upon receding and approaching magnets equally, resistance to motion would be experienced owing to the "squeezing" effect exerted upon the magnets *between* the fixed poles—S. Quint. If we had a telescope of the power you mention, the movements of Jupiter's surface would undoubtedly be magnified in the same enormous degree, and unless the effect of his rapid rotational motion were corrected there would be a rapid rush of the features across the field of view, with the blurring you speak of; but it would be the easiest thing in the world to correct this by the use of clockwork, keeping the telescope directed to a fixed point on any zone. In that case there would be no blurring at all.—E. A. Rowe. I am no arbiter of literary tastes. Nearly all the works you mention are popular.—F. Pitman. Have not seen the former work. A notice such as you send me would imply that I had and approved of it.—Geo. Jordan. What *will* you ask next? You want me now to explain why the moon is always full in the Arctic regions, why she never sets there,—and again you ask, "Can it be possible that there is a south pole as well as a north pole and the moon when crescented goes round the north centre and when at full she goes round a south centre?" And yet again, when I say the moon is every month half the time north of the celestial equator and the other half south, you "suppose in that case," I "refer to the month of June especially and only in June." (Now, is June *every* month?) Will you permit me to inform you, once for all, that the moon's behaviour in both the Arctic and Antarctic regions is precisely the same so far as her apparent form is concerned as it is anywhere else. When the moon is full here she is full *wherever she can be seen*, when gibbous gibbous, when crescent-shaped crescent-shaped. The moon is seen in the Arctic regions (and here, be it noticed, I am speaking of places well within the Arctic circle, not upon or *just* within it, but say north of seventy-two or seventy-three degrees) during part of every month, the particular part of each lunar month in which she is best seen varying as the year goes round. In December she is full when highest above the celestial equator, and consequently she is then visible as a full moon all through the night. In high Arctic latitudes she is visible in December all through the night from a few days before full to a few days after full. In January the part of the lunar month when the moon is seen all night ranges over a week or so, in high latitudes, to about the time when she is full. In February the week during the lunar month when the moon is visible all through the twenty-four hours ends a few days before the time of full moon. In March it ranges equally on either side of "half-moon before full." In April it ends at about the time of half-moon before full; and in May a few days earlier. In June there is no night, at least towards the end of the month; and at this time the moon is only visible above the horizon all through the twenty-four hours when near the sun or appearing as a fine crescent. She is invisible all through the twenty-four hours when nearly new in December near the time of midwinter; for about a week, ending at time of new moon, in January; a few days earlier in the lunar month in February; for a week equally divided on either side of half-moon after full in March; for a week ending at about half-moon after full in April; and a few days earlier in the lunar month, in May. The moon is invisible all through the twenty-four hours when nearly full near the time of Midsummer—in high Arctic latitudes—*i.e.*, four or five degrees north of the Arctic circle. You should find no difficulty in extending these considerations to the remaining months. Again, for the Antarctic regions, you have only to write July, August, September, October, November, and December, respectively, for December, January, February, March, April, and May, in the preceding account, to have a correct description of the phenomena there. You are bound to tell me that some of your old captains deny all this, and say the moon is always full in the Arctic regions, never sets there, can be seen full in high arctic latitudes at midsummer, and so forth. But besides these old captains there have been, let me remind you, sundry old Arctic captains not altogether unknown to fame, such as Sir E. Parry, Sir Jas. Ross, McClintock, and a few others, who have not—like yours—tried to recall, with obviously imperfect memories, what they

think they fancy they remember they saw, but have carefully noted all observed phenomena. It is hardly necessary to say that in all the multitudinous volumes of Arctic and Antarctic travels extant, no such absurdities as your old sea captains have told you are mentioned; but the moon, the guide of the sailor in remote seas, behaves within the Arctic circles as she behaves elsewhere: she is new, half full, gibbous, and full at the times given by the "Nautical Almanac" for the whole world; and in fact if she has anything at all to say to your sea captains' stories, informs you simply that either they have blundered, or (which is far more probable) they have amused themselves by telling old "forecastle yarns" for your edification.—H. Askew. (1.) The geometrical problems will probably be published. They were submitted, almost in their present form to Messrs. Longmans, in 1868, who submitted them to Professor Goodeve and Mr. Cock, mathematical lecturers at King's College, who studied them so carefully as to find out that the problems might be *more simply solved*—as if it were the object of the papers to show how those particular problems might be most briefly solved. (2.) We have unfortunately no space for obituary notices in Knowledge, except in the case of a few very eminent men such as Darwin, J. W. Draper, H. Draper, &c., whose influence on the advance of scientific thought has been very marked. (3.) The Harton Coalmine experiments gave 6·565 as the mean density of the earth. Mr. Sketchley probably means that this result raised the average of the best estimates to 5·480.—F. M. Duplock. Pray excuse the misspelling of name; "I" was not responsible for the mistake, but the fault was as you say with "U"; only U say this and I say it with different significance. Thanks for kind inquiries as to effects of railway accident. Have felt the shaking a good deal; but hope effects will shortly pass off. Though sitting with my back to the engine, only my knees show any marks! both of them bruised by the counter shock,—in other words I "cushioned" off the seat behind me on to my knees on the seat in front of me, with enough force to mark them both and to bark one. Rather an unusual way of bruising the knees!—G. S. See solution in our columns.—E. Const. May. Write down the first three odd numbers in order, each repeated twice,—thus 113355, and divide the latter half of the number thus formed, 355, by the former half, 113. The result is the ratio of the circumference to the diameter of a circle, correct to the first six decimal places: for the quotient is 3·1415929, &c., which to the sixth decimal place would be written 3·141593 as would the true ratio, which is 3·14159265, &c.—W. E. Drinkwater. The sun and moon both rule the tides, their respecting tide-raising influences being as the numbers two and five. When they combine their influence, the tidal wave bears to the lunar tidal wave about the ratio of seven to five; while, when they oppose each others' influence, the tidal wave is less than the lunar tidal wave (*i.e.*, the wave which there would be if the sun excited no effect) as three to five. Thus the solar influence produces no tidal wave separate from the lunar wave, but is, as it were, merged in the lunar influence. The tidal period follows the moon, but the variation of the tidal wave in height follows the sun.—T. M. Your theory is presented with assertion only. "The fact should be familiar to all," you say, and go on to give as a fact what is not only not familiar to all, but not a fact at all. As to alluvial and diluvial matter, astronomers find plenty of evidence of that in the moon; but perhaps this, being a fact, is not familiar to you.—T. C. Fear many readers would not see that you are jesting in finding "the number of the beast" in the name of the great and good man you mention—preposterous though the notion is. Some really do fancy they see the cloven hoof there, not being quite able to see above his instep.—R. F. Kerr. You are right in thinking that I utterly decline to answer your question. I simply cannot tell you what I do not know myself. If Knowledge cannot be honestly sold unless the editor tells you what he understands by what neither he nor any man who has ever lived *can* understand, then Knowledge must continue to be (in your opinion) sold dishonestly. J. C. S. That *Daily Telegraph* article about the midnight sun, earth's inclination, &c., belongs to a type which I had thought played out. It is nearly all nonsense, of course. If there were such a change as supposed, the present forms of vegetation in the temperate and Arctic regions would no longer be so well suited as they are at present. As for sudden change in earth's centre of gravity, that is nonsense, too. Adhémar's theory was wild enough in all conscience, without adding that absurdity.—W. Aston. I really do not know how you should set about to get a "cirtificate" to "an able" you to teach and pass pupils.—Geo. Howard. Pardon me, though you may have taken in Knowledge from the first, you are not an original subscriber. A copy of the index was sent gratis to every subscriber. It most assuredly is not the proprietor's duty to reprint the index at heavy cost, because one or two failed to provide themselves with it when it was issued. I differ from you altogether as regards the Whist Column. It has been discontinued during chess tourneys, but it will be resumed soon. Whist has as good a right to be described as a scientific game as chess or draughts.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By Richard A. Proctor.

PART XII.

Let us next try the following problem:—

Ex. 18.—*Determine the locus of the middle points of all the chords of a circle which pass through a fixed point.*

The fixed point may be either within or without the circle. In nearly all cases of this sort it is well to begin with a point within the circle, trusting to the result thus obtained to guide us in the case of a point without the circle.

Let P (Fig. 27) be a point within the circle A B C D. We are to draw chords through P, and to bisect them. Draw, first, the diameter A P E C through P. Its bisection, E, is the centre of the circle. This is one point of the required locus. Draw next the chord B P D at right angles to A C. Then the point P is itself the bisection of D B (Euc. III., 3). Therefore P is a point on the required locus. Next draw a chord F P H G through P, and bisect in H. Then H, a point on the locus, is clearly not in the straight line joining P E, so that the locus is not a straight line. It is, therefore, probably a circle. Now we see at once that for every point we get above A C there must be a corresponding point below A C. We see, then, the probability that the required locus is a circle of which P E is the diameter. But even if the student failed to see this at once, he would readily detect it when he had drawn several more chords through P (above and below P C), and bisected them. We describe, therefore, a circle C H P, of which we assume P E to be the diameter, and we look for a proof that a chord drawn as F P H G *would* be bisected in H where it meets the circle thus drawn. It will clearly be well to join E H. When this is done, one of two well-known properties can hardly fail to occur to our mind. We might either remember that the angle in a semicircle being a right angle,

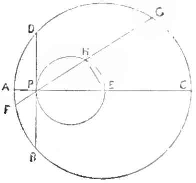


Fig. 27.

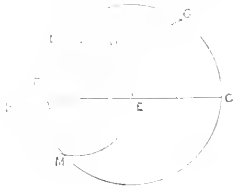


Fig. 28.

E H will be at right angles to F G, if P H E really is a semicircle, or we might remember that the line from the centre of a circle to the bisection of any chord is at right angles to the chord, so that the angle E H P is a right angle independently of any consideration of the assumed circle P H E. Of course, if we thought of the first property we should be led immediately to the second, and vice versa. The two properties are, in fact, interdependent; and we see at once that their interdependence involves the solution of our problem.

We now write out the solution in the following form:

Let A B C D be the given circle, P the given point.

First, let P lie within the circle. Draw any chord, F P H G, and bisect F G in H. Find E the centre of the circle A B C D, and join E H. Then E H is at right angles to F G (Euc. III., 3); therefore H is a point on the circle of which P E is a diameter. (Euc. III., 31). But F G is any chord through P. Therefore the bisections of all such chords lie on the circle E H P. Also it is clear that every point on this circle bisects some chord through P; therefore, this circle is the locus required.

Next, let P lie without the circle (Fig. 28). Then the proof is the same* up to the words, "therefore the bisections of all chords

* It is important to notice that in such a case as the above, *by putting the same letters at corresponding points in both figures*, the proof of one case may be made to apply to the other, either without change, or with such obvious changes as the student can have no difficulty in making.

through P lie on the circle E H P." But it is clear that points on the arc L E M bisect chords through P; and also that *every* point on this are bisects *some* chord through P.

A readiness in determining the loci corresponding to different conditions will often be found serviceable to the student engaged in solving problems of different classes.

Suppose, for instance, that the following problem is set :—

Ex. 19.—*Let A, B, C (Fig. 29), be three given points, D a given straight line. It is required to find a point which shall be equidistant from the points A and B, and at a distance from C equal to the line D.*

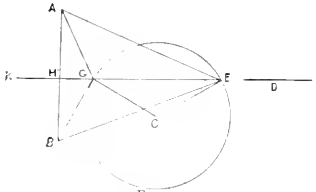


Fig. 29.

In order that the distance of the point from C may be equal to the line D, it is clearly necessary that the point should lie somewhere on the circumference of the circle described with centre C, and radius equal to D. Let G E F be this circle.

Next, we inquire whether there is any *locus* containing all points equidistant from A and B. We join A B and bisect in H, giving one point, H, clearly belonging to such a locus. Next, either by applying tentative methods, as in the above instances, or by the consideration of a few obvious facts, we find that the indefinite line, K H G E, drawn through H at right angles to A B, contains all points equidistant from A and B. The line K H G E does not *necessarily* intersect the circle F G E. If it intersects that circle in two points, G and E, it is clear that each of these points satisfies the required conditions. For C G is equal to D (*const.*), and G A is equal to G B (Enc. I., 4. See also Ex. 1.) Also, C E is equal to D and E A to E B. If K H G E touch the circle there is only one point satisfying the given conditions. And clearly, if K H G E do not meet the circle, there is *no* point satisfying the given conditions. For if there were such a point, it would be at a distance D from C; and, therefore, would lie on the circle F G E. Also it would be equidistant from the points A and B, and therefore would lie on K H E. In other words, the circle F G E *would* have a point in common with the line K H G E, which we have supposed not to be the case.

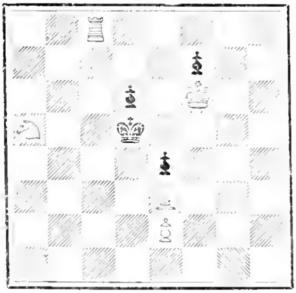
Our Chess Column.

By Mephisto.

PROBLEM No. 92.

By J. C.

Black.



White.

White to play and mate in three moves.

GAME PLAYED RECENTLY BETWEEN MEPHISTO AND ANOTHER STRONG PLAYER (SCOTCH GAMBIT).

	White. Mephisto.	Black. Amateur.		White. Mephisto.	Black. Amateur.
1.	P to K4	P to K4	10.	Kt to K4	B to Kt3 (*f*)
2.	Kt to KB3	Kt to QB3	11.	P to B4	Kt to Kt5
3.	P to Q4	P takes P	12.	Kt to B6(ch) (*g*)	P tks Kt (*h*)
4.	Kt takes P	Kt to B3 (*a*)	13.	B tks P (ch)	K takes B (*i*)
5.	Kt takes Kt	KtP takes Kt	14.	Q to R5 (ch)	K to Kt sq
6.	B to Q3 (*b*)	B to B4 (*c*)	15.	Q to Kt4 (ch)	K to R2
7.	P to K5	Q to K2	16.	Q to R4 (ch)	K to Kt sq
8.	Castles	Kt to Q4	17.	P takes P	Resigns (*j*)
9.	Kt to Q2 (*d*)	Castles (*e*)			

NOTES.

(*a*) This defence was adopted by Zukertort in his match against Blackburne. It leads to a difficult game for Black.

(*b*) Steinitz is of opinion that the P should at once advance to K5.

(*c*) P to Q4 ought to be played here; it is the principal move in Black's defence, for if White plays P to K5 the Kt can conveniently retire to Q2.

(*d*) Here P to QR3 first might have been preferable.

(*e*) Castling is always dangerous when all the pieces are placed on the Q side, and especially when the adversary's B is posted on Q3. Black ought to have played Kt to B5 instead, which would have enabled him, if necessary, to play Kt to K3, but his position was a difficult one to handle.

(*f*) If P to B4, then 11. P takes P *en pas*, Kt takes P. 12. B to Kt5.

(*g*) This combination forces the game.

(*h*) Obviously Black could not reply with K to R sq., on account of 13. Q to R5, P to KR3. 14. QB takes P.

(*i*) Here again Black has no resource but to accept his fate; if K to R sq., then 14. B to B5 threatens mate by Q to R5, or, if K to Kt2, then Q to Kt4 (ch) brings about the same position.

(*j*) There was no feasible way of preventing the threatened mate on Kt7; an interesting variation arises from the following play: B takes P (ch). 18. K takes B best (R takes B would be bad on account of Q to K8 (ch), and the R could not cover; Q takes B would be good, but it would render winning a little more difficult,) Q to B4 (ch). 19. K to Kt3, Q to Q3 (ch). 20. R to B4, Q to Q6 (ch). 21. K to B2, Q to R2, best. 22. Q to Kt3 (ch) and wins the Queen.

Contents of No. 93.

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CONTENTS OF No. 95.

TRICYCLES IN 1883.

SMALL WHEELS *v.* LARGE WHEELS.

By JOHN BROWNING,

Chairman of the London Tricycle Club.

IN a tricycling journal published this week, Mr. W. T. Shaw, who is the patentee of a two-speed gearing for which we have waited impatiently for nearly a year, accuses me, though in most courteous terms, of lending the weight of my name and official position to the promulgation in KNOWLEDGE of erroneous opinions as regards the best size for the wheels of tricycles.

Mr. Shaw states, at great length, that large wheels make fewer revolutions on their axles than small ones, and also that they pass with less resistance over obstacles in their path. These facts are, of course, well known to every tyro in mechanics. Mr. Shaw argues from them that tricycles with large wheels will travel easier than similar machines with small ones.

I have no hesitation in admitting Mr. Shaw's statements and denying his conclusions. As I am accused of "propounding false theories and advocating the construction of ideal tricycles," I will confine myself in my reply to practical and well-established facts, though there is not one single sentence in the article to which I am replying to lead a reader to suppose that the writer has ever ridden a tricycle.

Let me say briefly, that large wheels are very weak as compared with small ones, unless they are made so stout as to be excessively heavy, and that this extra weight greatly reduces the speed of the machine.

The small wheels of tricycles are *not* greatly retarded by obstructions, because the rims of our wheels have soft rubber tires, and most obstructions on the roads sink into these. Neither the machine nor the rider are lifted over them. Here is a proof: the Monarch is an excellent machine, probably the best made for very rough roads, yet its driving-wheels are only 40 in. in diameter. If our roads were strewn with Kentish flints or brickbats then large wheels might be necessary.

Mr. Shaw advocates, *theoretically*, the building of "machines with driving-wheels of 56 in. *or upwards* in diameter, geared level or down to 50 in., for ordinary running, with a second speed for hill-climbing, and a steering-wheel *not less* than 24 in." Such a machine, to be fairly strong, would require to weigh from 130 lb. to 140 lb., if not more.

Now I have found that, with a machine which has 50-inch wheels, weighing from 80 lb. to 90 lb., I must gear down to 36 inches to travel easily, and my pace on a journey which takes several hours will be from five to six miles an hour.

With a machine which has 38-inch wheels, weighing from 50 lb. to 55 lb., I can gear *up* to 46 inches, and travel for a greater number of hours at the rate of from seven to eight miles an hour. In other words, wheels 12 inches larger on a machine which weighs 30 lb. more reduces my pace by two miles an hour, and the distance I can travel by 25 miles in a day. For, on the heavy, large machines, from 30 to 40 miles in a day was a hard task for me, while on the small light machines I can travel *without fatigue* from 60 to 70.

But look at the authorities I am supported by. Mr. Marriott, a partner in one of the first, if not the leading, firms of tricycle manufacturers, and our first long-distance rider, uses a machine with 42-inch wheels, geared to run as 56 inches. Mr. S. Salmon, the Secretary of the London Tricycle Club, whose experience in tricycles and tricycle riding on roads is certainly not less than that of any man in the kingdom, rides a machine which he has aptly named the "Shadow," with 40-inch driving wheels geared to 48 inches, which weighs only 46 lb. Mr. Grace, of Anerley, a most careful and thoughtful experimenter, who has several machines of various sizes, considers (I am quoting his own words) "40 inches large enough for the wheels of any tricycle."

Mr. Arthur Salmon, one of the finest riders in the London Club, who is 5 ft. 10 in. high, has for two years ridden a machine with 52 in. wheels, and which weighed 96 lb. This year he is riding a machine of the same pattern with 42 in. wheels which weighs 65 lb., and, after six months' experience, he informs me that nothing would induce him again to ride one of the larger and heavier machines. Three years ago it might have been said truly that I was urging the use of small wheels and light machines theoretically. I was perfectly aware of their disadvantages, and believed, as it is now seen correctly, that they might, in mathematical language, be neglected.

But now that manufacturers, experimenters, and riders are agreed on adopting them, Mr. Shaw must give them something more than an array of figures—he must give them good reasons drawn from riding experience before he can expect them to go back to plans which he proposes as though they were new, but which they have already tried and found wrong.

Certain results I have obtained lead me to doubt if I have yet reached the limit to which wheels may be reduced with advantage.

I shall very shortly have made for me a single tricycle, with 36-in. wheels geared to 46, which will weigh about 45 lb., and a double tricycle with 36-in. wheels, which will not exceed in weight 100 lb., and, should these be slower than machines with larger wheels, I will acknowledge it.

To conclude, I am charged with tempting makers to build machines so light that they will be unsafe. Here is my reply. At the commencement of this season, when Messrs. Humber & Co. kindly undertook to build me my 38-in. machine, which weighs about $51\frac{3}{4}$ lb., to my own specification, they stipulated that I should not ride the machine on macadamised roads. Since then they have

told me voluntarily that they are confident that the mathine would carry safely a rider encycling, two stone more than myself over any roads.

In the last few weeks I have been trying four two-speed mahines, and very shortly will report on their performance.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XIV.

The beast-fables cited in my last paper were drawn from widely-severed sources, as illustrative of ideas common to all barbarous races, concerning the community of life in man and brute.

They are thus shown to embalm the relics of a serious philosophy, and the like is true of the great mass of folk-tales of which they are a branch. The connection of the two is, indeed, manifest in the group of which "Beauty and the Beast" is a well-known example, in which the husband or wife is of fair human form by night and a hideous monster by day, until freed from the sorcerer's enchantment. Such tales have not fallen in the East to the low level which they have reached here, because they yet accord in some degree with extant superstitions in India, whereas in Europe they find little or nothing to which they correspond. But, dismissing these, we will deal with a group of stories culled from various collections, the leading idea of which is the dwelling apart of the soul or heart, as the seat of life, from the body, in some secret place, as in an egg, or a necklace, or a flower; the destruction of the soul involving that of the body.

In the Norse tale of "The giant who had no heart in his body," the monster turns six princes and their wives into stone, whereupon the seventh and only surviving son, Boots, sets out to avenge their fate. On his journey he saves the lives of a raven, a salmon, and a wolf, and the wolf, having eaten his horse, compensates Boots by carrying him to the giant's castle, where the lovely princess who is to be his bride is confined. She promises to find out where the giant keeps his heart, and by blandishments and divers arts known to the fair sex both before and since the time of Delilah, she worms out the secret. He tells her that "far, far, away in a lake lies an island; on that island stands a church; in that church is a well; in that well swims a duck; in that duck is an egg; and in that egg there lies my heart, you darling!" Boots, taking fond farewell of the princess, rides on the wolf's back to the island. Then the raven he had befriended flies to the steeple and fetches the key of the church; the salmon, in like return for kindness, brings him the egg from the well where the duck had dropped it.

> Then the wolf told him to squeeze the egg, and as soon as ever he did so, the giant screamed out. "Squeeze it again," said the wolf; and when the prince did so, the giant screamed still more piteously, and begged and prayed so prettily to be spared, saying he would do all that the prince wished if he would only not squeeze his heart in two. "Tell him if he will restore to life again your six brothers and their brides, you will spare his life," said the wolf. Yes, the giant was ready to do that, and he turned the six brothers into kings' sons again, and their brides into kings' daughters. "Now squeeze the egg in two," said the wolf. With questionable morality, doing evil that good might come, Boots squeezed the egg to pieces, and the giant burst at once.

Some interesting variants of this story are given by Mr. Ralston in his "Russian Folk-Tales," in which Koshchei is the counterpart of the giant, his death being brought about by the destruction of the object in which his soul is hidden. In one story he is killed by a blow on the forehead inflicted by the mysterious egg—that last link in the magic chain by which his life is darkly bound. In another version the fatal blow is struck by a small stone found in the yolk of an egg, which is inside a duck, which is inside a hare, which is inside a stone, which is on an island. In another variant, Koshchei attempts to deceive his fair captive, pretending that his "death" resides in a besom, or in a fence, both of which she adorns with gold in token of her love. Then he confesses that his "death" really lies in an egg, inside a duck, inside a log which is floating on the sea. Prince Ivan gets hold of the egg, and shifts it from one hand to the other. Koshchei rushes wildly from side to side of the room. At last the prince breaks the egg, and Koshchei falls on the floor and dies.

In Serbian folk-tale the strength of a baleful being who had stolen a princess lies in a bird which is inside the heart of a fox, and when the bird was taken out of the heart and set on fire, that moment the wife-stealer falls down dead, and the prince regains his bride. In Bohemian, Gaelic, Greek, Finnish, as also among the Hottentot and Samoyed folk-tales, the same incident occurs of an external soul, generally hidden in an egg, the breaking of which ends the life of giant or other monster. In the "Arabian Nights" the Jinni's soul is enclosed in the crop of a sparrow, and the sparrow is imprisoned in a small box, and this again in seven other boxes, which are put into seven chests, contained in a coffer of marble, which is sunk in the ocean that surrounds the world. Seyfel-Mulook raises the coffer by the aid of Suleyman's seal-ring, and having extricated the sparrow, strangles it, whereupon the Jinni's body is converted into a heap of black ashes.

The most venerable form in which we possess the myth of a man's soul outside his body comes to us from the valley of the Nile, but before narrating this we must seek in the "storied East" the close parallels to the folk-lore of the Western Aryans. As in the Rig-Veda we are in certain respects nearer to the older forms of the parent language of the Indo-European peoples, so in the folk-tales of Bengal and the Deccan we are nearer the earliest forms of the fireside stories of both east and west.

In the story of "Punchkin" given in Miss Frere's "Old Deccan Days," a Rajah has seven daughters, and his wife dying when they were quite children, he marries the widow of his prime minister. Her cruelty to his children made them run off to a jungle, where seven neighbouring princes, who were out hunting, found them, and each took one of them to wife. After a time they again went hunting, and did not come back. So when the son of the youngest princess, who had also been enchanted away, grew up, he set out in search of his mother and father and uncles, and at last discovered that the seven princes had been turned into stone by the magician Punchkin, who had shut up the princess in a tower because she would not marry him. Recognising her son, she plotted with him to feign agreement to marry Punchkin if he would tell her where the secret of his life was hidden. Overjoyed at her yielding to his wish, the magician told her that it was true that he was not as others.

> Far, far away, hundreds of thousands of miles from this, there lies a desolate country covered with thick jungle. In the midst of the jungle grows a circle of palm-trees, and in the centre of the circle stand six chattees full of water, piled one above another; below the sixth chattee is a small cage which contains a little green parrot; on the life of the parrot depends my life, and if the parrot is killed I must die." But, he added, this was not possible, because thousands of genii "surround the palm-trees, and kill all who approach the place."

The princess told her son this, and he set forth on his journey. On the way he rescued some young eagles from

a serpent, and the grateful birds carried him until they reached the jungle, where, the genii being overcome with sleep by the heat, the eaglets swooped down. "Down jumped the prince; in an instant he had overthrown the chattees full of water and seized the parrot, which he rolled up in his cloak," then mounted again into the air and was carried back to Punchkin's palace. Punchkin was dismayed to see the parrot in the prince's hands, and asked him to name any price he willed for it, whereupon the prince demanded the restoration of his father and his uncles to life. This was done; then he insisted on Punchkin doing the like to "all whom he had thus imprisoned," when, at the waving of the magician's wand, the whole garden became suddenly alive.

"Give me my parrot!" cried Punchkin. Then the boy took hold of the parrot, and tore off one of his wings; and as he did so the magician's right arm fell off. He then pulled off the parrot's second wing, and Punchkin's left arm fell off; then he pulled off the bird's legs, and down fell the magician's right leg and left leg. Nothing remained of him save the limbless body and the head; but still he rolled his eyes, and cried, "Give me my parrot!" "Take your parrot, then," cried the boy, and with that he wrung the bird's neck, and threw it at the magician, and as he did so, Punchkin's head twisted round, and, with a fearful groan, he died. Of course, all the rest "lived very happily ever afterwards," as they do in the plays and the novels.

In the story of "Sodewa Bai," the Hindu Cinderella, the heroine's soul is contained in a string of golden beads. and in the Bengali tale, "Life's Secret," a Rajah's favourite wife gives birth miraculously to a boy, whose soul is bound up in a necklace in the stomach of a boal-fish. In both instances the jewels are stolen, and while they are worn by the thieves, prince and princess alike are lifeless, whilst with the recovery of the jewels, life returned to each.

The family likeness of these Indian folk-tales to those given above is explicable on no theory of borrowing, and finds its sole and rational explanation in the possession of a common stock of folk-lore by the several ancestors of the Indo-European races. As Sir G. W. Cox remarks, "the substantial identity of stories told in Italy, Norway, and India can but prove that the treasure-house of mythology was more abundantly filled before the dispersion of the Aryan tribes than we had taken it to be."

The Egyptian tale of the "Two Brothers" is of great value on account of its high antiquity, and, moreover, specially interesting as recording an incident similar to that narrated in the life of Joseph. It is contained in the d'Orbiney papyrus preserved in the Bibliothèque Impériale, the date being about the fourteenth or fifteenth century B.C.

There were two brothers, Anepou and Satou, joined as one in love and labour. One day Satou was sent to fetch seed-corn from Anepou's house, where he found his brother's wife adorning her hair. She urged him to stay with her, but he refused, promising, however, to keep her wickedness secret. When Anepou returned at even, she, being afraid, "made herself to seem as a women that had suffered violence," and told him exactly the reverse of what had happened. Anepou's wrath was kindled against Satou, and he went out to slay him; but Satou called on Phra to save him, and the god placed a river between the brothers, so that when day dawned Anepou might hear the truth. At sunrise Satou tells his story, and, mutilating himself, he says that he will leave Anepou and go to the valley of the cedar, in the cones of which he will deposit his heart, "so that if the tree be cut, his heart would fall to the earth, and he must die."

Space forbids further outline of the venerable story, which finally ends with the reconciliation of the two brothers.

For us the value of these folk-tales lies in the relics of barbaric notions concerning the nature of man and his relation to external things which they preserve. They have amused our youthhood: they may instruct our manhood. Not if we go to the solar mythologist for their interpretation. We shall learn from Sir G. W. Cox that "the magician Punchkin and the heartless giant are only other forms of the Panis who steal bright treasures from the gleaming west," that "Balna herself is Helen shut up in Ilion . . . the eagles the bright clouds,"* and from Professor de Gubernatis that the duck is the dawn and the egg the sun.

These venerable tales have a larger, richer meaning than this, expressive of the wonder deep-seated in the heart of man. Like the beautiful prisms of topaz and beryl revealed when a "drusy" cavity in granitic rock is broken open, they hold within them the crystallised thought of the past. The soul existing apart from the body, whether in bird or casket, and determining its fate, is the relic of barbaric belief in one or more entities *in* the body, yet not *of* it—a belief extant among tribes still uncivilised, and surviving in unsuspected forms among more advanced races.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

III.

(*Continued from page* 90.)

"Full many a flower is born to blush unseen,
And waste its fragrance on the desert air;
Full many a gem of purest ray serene
The dark unfathomed caves of ocean bear."

The adult animal dwells in the deep sea beyond low-water mark, and in Torbay and Weymouth Bay is found in great abundance, at depths varying from three to thirty fathoms. The young, in large numbers, are met with between tide-marks in pools, or suspended from the roofs of rocky hollows, like white nipples, each with a dependent globule of water, resembling a dew-drop. These young dianthuses change their position spontaneously, and remove into deep water as they approach maturity. They are rarely ever met with between tide-marks exceeding, when in button form, an inch in diameter. In early youth the characteristic convolutions of the disk, with its feathery aspect, are not displayed; and incautious observers are very liable to mistake a young dianthus for an anemone of another species. Both Dalyell and Gosse confess to this error of judgment.

This species is gregarious; the dredge and the trawl constantly bring up clustered groups, and sometimes the clusters are very numerous. A trawler (see Gosse, "Action," p. 21) brought into Torquay a board, two feet long and one foot broad, on which were crowded between four and five hundred specimens of A. dianthus. "What was curious was that all one side of the board were white, all on the other orange."

The reproduction of this anemone by spontaneous division is very common. When it chooses to change its position it does so by moving the base slowly—too slowly,

* "Mythology of the Aryan Nations," Vol. I., p. 140. n.

indeed, for the eye to appreciate its movement; yet if its course be, as it usually is, from the bottom to the top of the glass front of the tank, it will be marked out plainly by the track left behind. Minute fragments of the base are seen to adhere to the glass, which very soon contract into a rounded form, and begin to grow tentacles round a central mouth, and in time the minute creatures equal in size the elder original. This increase by separation of parts is analogous to the multiplication of plants by cuttings. In both cases the colour remains unchanged; whereas, in the propagation of plants by seeds and of anemones by real germs, the colour of the new production is arbitrary and inconstant.

Sometimes the irregular fragments, torn, as it were, from the base, in contracting make two circular forms united by a filament, and as the contraction continues, the uniting link becomes a fine thread, and finally breaks, when two individual anemones are formed. In this manner monstrosities probably have their origin; the connecting thread is not broken, and the two individuals grow up in contact, or united together, and an individual appears with one body and two disks.

At the present moment, in tank No. 10, two very handsome anemones, a white and a buff dianthus, are attached to the front glass. They are nearly equal in size, and correspond fairly well in dimensions to Figs. 1 and 2 in the preceding article (page 89), except that their bodies are much shorter than in Fig. 2, which is possibly in consequence of their position.

A favourite practice with dianthus is to mount the side of the tank as high as the edge of the water, and to remain there protruding its column horizontally, and distending its frilled disk so that the air and water are equally and mutually in contact with opposite parts of the base column and disk.

No British anemone is more hardy, or more readily accommodates itself to confinement, than dianthus; neither is it what is termed a coy or a shy creature. It freely expands and appears in flower during daylight.

Still, it must be remembered that its natural habitat, and that of all the sea anemones, is in the "dark caves of ocean."

Bearing this fact in mind, Mr. Gosse has very sagaciously pointed out the best way to make sure of seeing a tank of anemones under the most favourable possible circumstances, and at a time when all its occupants will be most likely to display the full beauty of their gorgeous bloom.

His advice to the benevolent reader is that he should adopt Sir Garnet Wolseley's *beau stratagème*, so successfully executed at Tel-el-Kebir against the Egyptians; which, of course, is to steal a night-march upon your enemy and catch them napping. His words are :—"Visit your tank with a candle an hour or two after nightfall."

Some individuals of this species are voracious feeders; they swallow and partially digest bits of raw mutton and fish once in two or three days, and grow wonderfully larger and handsomer after each meal. The portions of food eaten, so to speak, by anemones are retained for several hours—sometimes days—and then vomited along with true germs and egg-germs in many of the species.

Anemones are fed according to their appetite upon raw beef, mutton, fish, oyster, mussel, cockle, limpet, &c. A small fragment is held within reach of the feelers or placed upon the disk. All the varieties which feed freely soon degenerate in size and colour if they do not receive their supplies regularly.

An American dianthus—and in accordance with the eternal fitness of things the biggest ever seen—is reported upon and figured in the great American work edited by J. W. Dana,* as follows:—*Actinia Paumotensis.* From the coral reefs Paumotu Archipelago.

Smooth exterior, 6 in. thick at middle, above very widely dilated (12 in.), tentacles numerous, covering the larger part of the disk, yellowish-white, tipped with lake, and marked with eight or nine transverse lines; mouth but little prominent (*J. Drayton*).

This species was truly magnificent when seen in the water, the disk expanding at least a foot in diameter, densely covered with tentacles, the margin undulating so as to form numerous lobes, each of which had the appearance of being a separate actinia, the whole resembling a beautiful bouquet (*J. P. Couthony*).

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(*Continued from page* 102.)

I HAVE received from a number of readers questions relating to the determination of the actual amount of depression of the earth's surface from a tangent line at any point at given distances from the point of contact. In particular some perplexity seems, strangely enough, to be occasioned by statements as to the distance at which lighthouses of given heights have been seen from ships at sea.

The actual depression of the earth's globular surface, below a true tangent, is almost exactly 8 inches at a mile's distance from the point of contact; four times this or 2 ft. 8 in. at two miles' distance; nine times 8 in. or 6 feet

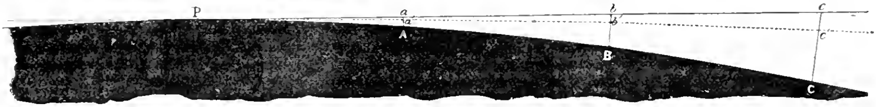


Fig. 11.

at three miles' distance; and so on,—the depression increasing as the square of the distance. Thus if PABC (Fig. 11) is a part of the earth's surface, abc a tangent line at P, aA, bB, cC vertical lines to the surface PABC; then if $Pa = ab = bc = 1$ mile, $Aa = 8$ in.; $Bb = 4Aa = 2$ ft. 8 in.; $Cc = 9Aa = 6$ ft. &c.

But the optical horizon line, tangent at P, has a slightly curved course as $Pb'c'$, owing to the refractive effects of the atmosphere. Though this curvature Aa, Bb, Cc are each reduced by about one-fifth so that

$Aa' = 6\frac{2}{5}$ in.; $Bb' = 4Aa' = 2$ ft. $1\frac{3}{5}$ in; $Cc' = 9Aa' = 4$ ft. $9\frac{3}{5}$ in. &c., nearly enough. Refractive effect varies, sometimes

* "Zoophytes," Vol. VII., p. 141. A fine copy of this really splendid work, "Presented by the United States Congress to the Government of Great Britain," can be consulted in the British Museum Reading-room.

diminishing the geometrical depression by as much as a fourth or even more, sometimes by barely a sixth or even less. For ordinary rough calculations it suffices to put 6 in. for the optical depression due to one mile.

It is easy to deal with any problem requiring us either to find the distance of the sea-horizon for any given height of the eye above the sea level, or *vice-versâ* to determine what is the height of the eye when the sea horizon lies at a given distance. For, if d is the optical depression for one mile, D the depression in inches at a distance of n miles, we have $D=n^2d$; $n=\sqrt{\frac{D}{d}}$; and d may usually be taken equal to half a foot.

Suppose, for instance, the problem—*If the eye is 20 feet above the sea level, how far off is the sea horizon?*

Here we have, taking a foot as the unit of length, and $d=\frac{1}{2}$ ft.

$$n=\sqrt{20\div 2}=\sqrt{40}$$
$$=6\tfrac{1}{3} \text{ approximately}$$

If we had put $d=6\frac{2}{5}$ inches, we should have had, taking the inch as the unit of length,—

$$n=\sqrt{240\div\frac{32}{5}}$$
$$=\sqrt{\frac{1200}{32}}=\sqrt{37{\cdot}5}$$
$$\text{or } n=6\tfrac{1}{9} \text{ approximately.}$$

or 278 feet for the height of the Galley Head Light which is known not to be half that height above the sea level.

Let us see how the problem should be dealt with, taking first the 8 inches per mile which corresponds to the depression of a geometrical tangent line.

Let L P O (Fig. 12) be the earth's surface, l the light, o the place of the observer's eye, $l\,P\,o$ touching L P O at L; let L l be the height of the lighthouse, O o the height of the observer's eye above the sea, or 16 ft. Then

$$PO=\sqrt{16\div\tfrac{2}{3}}=\sqrt{24}=4{\cdot}9 \text{ nearly}$$
$$\therefore\ lP=21-4{\cdot}9=16{\cdot}1 \text{ miles}$$
$$\text{and } Ll=8\times(16{\cdot}1)^2 \text{ inches}$$
$$=173 \text{ feet,}$$

rather less than 278 feet.

But putting $d=6$ in. we reduce the height L l still more remarkably. For then we have

$$Po=\sqrt{16\div\tfrac{1}{2}}=\sqrt{32}=5\tfrac{2}{3} \text{ nearly enough}$$
$$\therefore\ lP=21-5\tfrac{2}{3}=15\tfrac{1}{3} \text{ miles}$$
$$\text{and } Ll=6\times(15\tfrac{1}{3})^2 \text{ inches}$$
$$=1{,}411 \text{ inches}=117 \text{ ft. } 7 \text{ in.}$$

Yet honest Parallax and his erudite followers quietly substitute 278 feet or thereabouts as the true height of a light seen 21 miles over a sea horizon by an eye 16 feet above the sea level! And one of them has just, with the manners of his tribe, told Prof. Tyndall he has wilfully lied in the matter. Such is the honesty of some flat-earth men; such the ignorance of others; and such the polite suavity of them all.

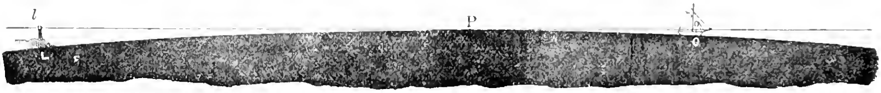


Fig. 12.

Again, suppose the problem,—*If the sea horizon lies 20 miles away, how high is the eye above the sea level?*

Here we have, taking the inch as the unit of length, and $d=6$ inches,

$$D=(20)^2\ 6 \text{ inches}$$
$$=200 \text{ feet.}$$

If we put $d=6\frac{2}{5}$ inches, we get instead

$$D=(20)^2\ \frac{32}{5} \text{ inches}$$
$$=80\times 32 \text{ inches}$$
$$=2560 \text{ in.}=213 \text{ ft. } 4 \text{ in.}$$

Let us next take a class of problem scarcely less simple, but of more general use.

In a letter recently addressed to the Daily News, *Prof. Tyndall says that going out in the steam yacht the* Princess Alexandra *to a distance of* 21 *miles from the Galley Head Lighthouse, the earth's rotundity coming between them and the shore, the light "dipped" beneath the horizon. Supposing the eye of the observer to have been* 16 *feet above the sea-level, what is the height of the Galley Head Light above the same sea surface?*

The way in which Parallax and his followers solve the problem is as follows. For 21 miles the depression of the sea surface below a tangent-line is 8 in. multiplied by the square of 21, or 441—*i.e.* 294 feet. Hence the beacon light "must have been" (here I quote one of those worthies) "294 feet above the sea level minus the eight or ten feet of the steamer's deck." Taking 16 feet for the height of the eye above the sea, this would give 294−16

HOW TO GET STRONG.

REDUCING FAT.

We have been asked why we have given attention so fully to the question of reducing weight, as if this were a point of primary importance in athletics. Our reason has been that many who read (*redde*) our former remarks complained that owing to corpulence or excessive weight they found several of the suggested exercises either impracticable or at least very trying and unpleasant. Unquestionably nearly all exercises for increasing the strength of particular muscles are much more agreeable and effective when extra fat has been removed; and since nearly all the methods available for reducing weight are good for the bodily strength generally, we have thought it well to deal with this really important part of our subject before passing to the consideration of systematic exercise, as we shall presently do. This remark as to the effect of fat-reducing processes applies of course with special force to the considerations next to be dealt with, which relate to the forms of exercise best suited for reducing weight.

As a general rule it may be said that the most effective exercises for reducing the weight are those which act most effectively on the respiratory organs. Running for instance is far more quickly effective in this way than walking, though quick walking is a very excellent exercise for the purpose. A steady run taken every morning before breakfast, and another taken every evening shortly before retiring to rest will be found to produce a marked effect on undue deposits of adipose tissue. But here a word of caution

such as we used in the beginning of these papers (in June, 1882) should be repeated. To any one who is thoroughly out of condition, especially if he has long been so, running is rather a dangerous exercise. To run a couple of hundred yards at a moderate rate might do serious injury to a man well advanced in middle age who has long been fat and unwieldy. But even a man of forty not very much out of condition, who has for several years taken little active exercise, ought to be careful how he starts to run more than a few hundred yards, except at a very moderate pace. The best plan is to begin for a week or two with about two hundred yards (unless very heavy) run steadily, but each day a little more sharply. By the time that distance is run at a good sharp pace, the second wind will come easily. Then the distance can be safely increased, until after awhile the morning and evening run is from half-a-mile to a mile in length. It is well to walk out whatever distance one proposes to run (pacing 200 yards for instance at about a yard a pace) and to run home, going then to bedroom or dressing-room to make any necessary changes of dress and to rub down. Although no man should consider himself in decently good condition if he cannot run half-a-mile at a moderate pace without being obliged to change his inside clothing (on account of the freedom with which he has perspired), yet a fat-reducing man is not likely to get through his morning or evening runs without freely perspiring over his work. He should never suffer his wet flannels to remain on him to dry.

Riding and rowing are both good exercises for reducing fat, and tricycling is even better. Boxing, fencing, and single-stick, are also excellent. Bowling and quoits are good, and skittles first-rate. Paterfamilias will find bowling for an hour or two to his boys at their cricket practice, very good exercise for reducing fat, and very pleasant if he chances to have any bowling skill. If he has not, then it would be perhaps rather wearisome. Capital exercise can be obtained by removing from a good-sized room all easily breakable objects, and then playing with a light elastic ball, thrown in such a way against the wall that some activity is necessary to take it, either by catching or with stroke of hand or racket. In an open air court this is of course much better. And it is hardly necessary to say that lawn-tennis, racquets, and all such exercises are excellent for reducing undue weight. But I am here specially considering those who, being unwieldy, are not particularly anxious to exhibit their unwieldiness before the eyes of friends and acquaintances by taking part publicly in such games as lawn-tennis or cricket. Even rowing is not a very soothing exercise to the obese if the ubiquitous 'Arry welcomes the athlete's exertions with cries of "well rowed fatty" or other uncomplimentary comments on his volume.

Taking too much exercise is a ready way of increasing fat,—paradoxical though it may sound to say so. A man not in good condition will perhaps take two or three days of very active or even violent exercise, drinking so much more than is necessary, on account of the unusual solicitations of thirst, that he can register very little loss of weight. Then he "caves in" for several days, being used up and feverish. During these days he eats drinks and sleeps more than usual, takes less exercise even than he had taken before he thus suddenly roused himself to exertion; and ere he is quite himself again, he finds, on weighing, that he has added to his bulk instead of diminishing therefrom.

In regard then to exercise as to all other methods for reducing undue fat, we advocate moderation on the one hand and steady perseverance in well-doing on the other. Do not go in for great feats of strength or endurance to be followed by long spells of rest, but for steady exercise, continued systematically. If the other methods for reducing weight (all but the medicinal one which is only to be adopted, and that cautiously and with medical advice, at the beginning) be followed steadily and moderately, for weeks and months, not for a few days only, the weight will be reduced safely to its proper amount, the breath and spirits improved, and the value of life notably increased.

(To be continued.)

THE COMMA.

By Richard A. Proctor.

The *Brighton Herald*, in a kindly notice of Knowledge, makes the following remarks on my remark that one of my own favourite *bêtes noires* is the constant custom among compositors of adding a comma after "and" in sentences beginning, "And therefore," "and because," and the like:—

We think Mr. Proctor is in the wrong. The "therefore" really stands in a parenthesis, which the commas very properly denote. Take as an example the following sentence:—"He called for help, and, therefore, I went to him." It is perfectly clear that the "therefore" is equivalent to an explanatory subsidiary sentence; the full sentence being, "He called for help, and, because he called for help, I went to him." The elision of the explanatory parenthetical sentence is indicated by the "therefore," and for that reason, if for no others, the use of the comma is perfectly justifiable. Mr. Proctor's appreciation of that useful point, the comma, seems to be on a par with that of the sign-writer who, being asked why he put a comma in the middle of a name, declared that he always supposed that "those little curly-cues" were put in for ornament! If otherwise, we would like to know how he justifies the presence of a comma in this sentence, "A few strong-minded women, may try the new dress" (p. 362). We suppose the printers are to be blamed; and the same with regard to the remarkable statement on p. 328 that "The farmer who was with us had several times turned up with the plough large pieces of *camel!*" These eccentricities are scarcely worth notice, but, when Mr. Proctor goes out of his way to assail respectable usages sanctioned by general custom (which, we take it, is the chief standard for testing good or bad grammar), he ought to be twice certain that he has no holes in his own coat. There is enough slovenly writing sent out, without Mr. Proctor using his influence on the wrong side. Let Mr. Proctor say what he likes about the moon, the stars, the earth, or even the sun itself, as to which an error of a few thousand or millions of years make little difference to anybody, but do pray let him leave the humble comma in the enjoyment of its rights and privileges!

Of course the errata referred to in the latter half of this paragraph are no faults of mine,—"camel" for "cannel" occurs in an article by my friend, Mr. W. M. Williams, and was overlooked by him no doubt in correcting proof. But I must confess to some little amusement at the way in which the writer of the above paragraph quietly assumes that my remarks on the use of the comma are the outcome of a careless disregard of the principles of punctuation. Twenty years of careful writing, every sentence penned with the thought of my readers and of their possibly misapprehending my meaning ever present before me, have not, let me assure my friendly critic, resulted in any such feeling about the "humble comma." On the contrary my objection to the set customs of compositors have had their origin in the recognition of the extreme importance of those "little curly-cues." Long experience and attentive observation have satisfied me that of all the marks of punctuation the comma is the most important.

So much might have been recognised from the parts of my Gossip note which the writer in the *Brighton Herald* has not noticed. The constant custom of putting a comma before "which" leads to constant alterations of a writer's real meaning. One writes: "the stars which are of

a ruddy colour are usually," &c.; and the "constant custom" makes him say, "the stars, which are of a ruddy colour, are usually," &c., which is absurd. So with the constant custom of putting a comma before "because." I came only a few days ago on a sentence in one of Mr. Herbert Spencer's works in which his meaning had been entirely altered by such an addition (probably the comma escaped his notice in correcting proof, or, quite possibly, it had been added by that fearful being who, unless strictly warned off, goes over the last proofs, scattering commas over every page apparently with a pepper-castor. The sentence ran somewhat like this as written: "Whales are not classed with fish because they resemble fish; but"—so and so; the constant custom of compositors setting a comma before "because," made Mr. Herbert Spencer state, absurdly, that the reason why whales are not classed with fish is that they are like fish.

With regard to the particular use of the "comma" referred to in the above quotation, I object to that constant custom only when applied to unsuitable cases. Nearly always the words "and therefore" and "and because" may be regarded as forming a single conjunction, almost as though "and" were an enclitic. The sentence given by my critic is a case in point—"He called for help, and therefore I went to him." Here if the "and" were omitted no one would think of adding a comma after "therefore." Adding the "and" as it does not alter the sense gives no reason for introducing a comma which would not be wanted if the "and" were left out. [The compositor is entreated not to put in a "comma" before the "which" in the last sentence.] A fair test of the propriety of the two commas on which the critic insists is obtained by uttering the sentence aloud, as it would be spoken. For it must be remembered that though speech is often slovenly, written language represents speech,—only it should represent carefully-spoken words. Now, no one would think of saying, "He called for help, and"—a pause—"therefore"—a pause—"I went to him." Not only so, but there is hardly a single case in which there ought to be a comma on both sides of the word "therefore" preceded by "and." A comma should often follow the "therefore," as for instance in the following sentences:—"He asked for help in his contest with Watson, so I gave it; and therefore, Watson has never forgiven me"—at least if one wished to dwell somewhat on the fact that it was because of this interference that Watson had remained irreconcilable. Adding the comma emphasizes this particular point. So in the other sentence, if one wished to emphasize the reason, one would add a comma after "therefore." Thus, "Why on earth did you go to him?—Why? Why, because he asked for help; because he and I were old friends; because I thought it my duty: therefore, I went to him." This would be reasonable enough; though note that here the "and" has necessarily dropped out.

But "And, therefore," is simply monstrous—no good writer ever allows such an absurdity to remain, if he can possibly help it. Putting "however" between commas is not quite so bad; though I remember hearing a writer who has perhaps a greater mastery of the art of stating a case than any man living (he has written a good deal in these columns, though anonymously) complain strongly of this constant custom. Here, however, there is some reason for the practice, because (as in this sentence) the word "however" comes in by itself, and might be omitted, like words within parentheses, without making the sense incomplete. In quite a number of cases however the commas are better omitted, especially in long sentences where commas are wanted for more important purposes. Just as the mathematician who has to deal with complicated expressions does not begin to use brackets before he wants them, so is it with the writer who has a long or complicated sentence to deal with. Indeed, as De Morgan long since pointed out, the use of commas, parentheses, dashes, &c., is akin to the use of brackets by mathematicians. I think he even went so far as to say that only mathematicians are likely to punctuate properly; but that is going a little too far.

With regard to the comma before "because," the sense is usually a safe guide. Putting a comma between "and" and "because" is seldom right, though it is a constant custom. The great disadvantage of doing it constantly is that if we do, then, when it is really wanted for a purpose, it does not answer. Thus in the following sentence it is not wanted: "I went to Ventnor, and because I wished to see the lovely neighbourhood I went early." Here the "constant custom" would insert two commas, one before "because," the other after "neighbourhood;" but neither is wanted. (Of course, a comma after "neighbourhood," alone, alters the sense.) But in the following sentence the comma is desirable:—"I hold that men should do their best to advance knowledge; and, because this seems to me an almost sacred obligation, I mean to fulfil the duty to the best of my power." Here, indeed, the comma would only be added for the sake of emphasis: it is not necessary to the sense.

I am aware that many superficial students of style consider that Macaulay solved the whole problem by his use of short sentences; scarce a semicolon to a chapter. With such sentences we need not be careful about commas; we have "points given," so to speak. But Macaulay shirked the real difficulties. Short sentences, like simple Saxon words, are often the best. But just as there is often occasion for the use of long words as the most suitable and weighty (Mr. Herbert Spencer has shown this well in his excellent essay on style), so it is often desirable—much oftener, in fact—to use long sentences. Nothing, indeed, is much more wearisome than the constant iteration of short sentences. When long sentences are in question we have to be careful with our commas, because when they run short we are driven to the use of parentheses, dashes, and so forth, just as the mathematician, when he has utilised ( ) and [ ], has to fall back on { }, and the like, for his bracketing.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. IV. BREAD-MAKING.

I FEEL that here I must be careful not to trench on the subject-matter of the admirable series of papers on the Chemistry of Cookery, by my able colleague, Mr. M. Williams. The difference in the stand-point taken by him and myself will, I think, prevent the two sets of articles seriously over-lapping each other.

The first step in the making of bread is to grind the wheat or other grain into flour: this operation is usually performed by introducing the grain between two flat stones, the upper one of which revolves rapidly on the lower. These stones are made of a very hard grit, and have thei rubbing-faces cut in a peculiar manner. There are first a series of deep radial grooves, whose object is to permit the flour to find its way from the centre outwards; the grain being fed from a hopper to the centre of the mill, and the flour collected from the circumference. In addition to these grooves there are a number of very fine lines cut on the stone's face, in order to produce a cutting surface. After

the mill has been worked for a short time, it becomes necessary to "dress" or re-cut these lines on the surface of the millstone. This operation requires a considerable amount of skill, and is performed by means of a heavy hammer with a chisel cutting edge, set at right angles to the hilt (something like certain makes of geological hammers). Blow after blow is struck with this implement until the line is sufficiently deepened and a good cutting-edge is produced. There are usually about eight or ten of these lines to the inch. It will be readily understood that a single false blow may undo a lot of careful work by destroying or damaging one of these delicate ridges. At present, in many large mills the stones are dressed by machinery. The cutter consists of a small steel wheel with a number of little diamonds embedded in its circumference. The machine provides for the rapid revolution of this cutter at the same time that it is drawn along the surface of the stone in the direction in which the fine lines run. The diamonds thus dress the stone with remarkable speed and accuracy.

The flour as it leaves the stone is termed "whole meal"; it contains the starch, &c., in the form of very fine particles, while the husk of the grain is simply cut into fragments of sensible size, which in the case of wheat-flour constitute the bran. Brown bread is either made from whole meal or from white flour to which bran has been added. Most people prefer, as a staple article of consumption, bread made from flour deprived of its bran. The miller removes this material by passing the flour through a number of sieves of varying degrees of fineness; in this way the husk is separated in different degrees of coarseness; "bran," "pollard," and "sharps" are names given to three grades of the separated husk—bran being the coarsest, and sharps the finest of the three.

The bran and the white flour produced from the interior of the grain differ considerably in composition, there being much more nitrogenous matter in the former than in the latter, which, on the other hand, contains a much higher percentage of starch. We have here a most important question to consider, because the nutritive value of bread must depend largely on its composition. Speaking generally, we may divide food-stuffs into two groups—first, the nitrogenous or flesh-forming substances, termed by the physiologist "proteids," and, second, the non-nitrogenous or fat-forming and heat-producing substances. The nitrogenous food-stuffs are also efficient as maintainers of animal heat. It is necessary for the healthy continuance of life that both nitrogenous and non-nitrogenous articles of food be eaten. Animals fed exclusively on non-nitrogenous diet speedily emaciate and die; life is, however, much more prolonged in those entirely fed with nitrogenous food. The value of bread as an article of food is greater the more nitrogenous matter it contains, provided the nitrogenous matter is of such a nature as to be readily assimilated by the stomach. From time to time the use of whole-meal bread has been urgently advocated on the score of its greater nutritive power; but the larger proportion of nitrogenous matter it contains is largely compensated by its being practically insoluble. The bran of whole-meal bread is found to be discharged from the system in an almost unchanged condition. From its producing a mechanical irritation of the inner surface of the intestine, it often acts beneficially in cases of chronic constipation.

Dealing first with white flour, a momentary reference may be made in passing to other methods of cooking it than making bread. Dumplings, suet-puddings, &c., consist essentially of flour mixed with suet or other fat, kneaded with water into dough, and subsequently boiled. The chemical changes thus produced are very slight, the principal one being the gelatinising of the starch.

The simplest form of bread is the ship-biscuit, or "hard bread" of the sailor. To make these biscuits, flour with a little salt is kneaded with water into a stiff dough. This is rolled into a thin sheet and cut into biscuits, which are at once rapidly baked in an oven. Although hard, ship-biscuits of good quality have an agreeable flavour, and when soaked in hot coffee and then buttered, form an appetising dish. Bread of this kind is particularly valuable for sea-going purposes, because it may be kept in a dry place for almost an indefinite length of time without undergoing any change.

It would be difficult to persuade many landsmen that ship-biscuit at all deserves the name of bread. Perhaps with the sailor, who invariably so terms it except when he uses the phrase "hard tack," the wish is father to the thought. Biscuits, whether ship or otherwise, certainly do not fall within our ordinary definition of bread, which may be described as the flour of wheat or other grain made into a paste with water, then rendered porous by being charged with carbon dioxide gas (formerly termed carbonic acid gas), and next baked by the heat of an oven into loaves with a light brown crust and porous interior.

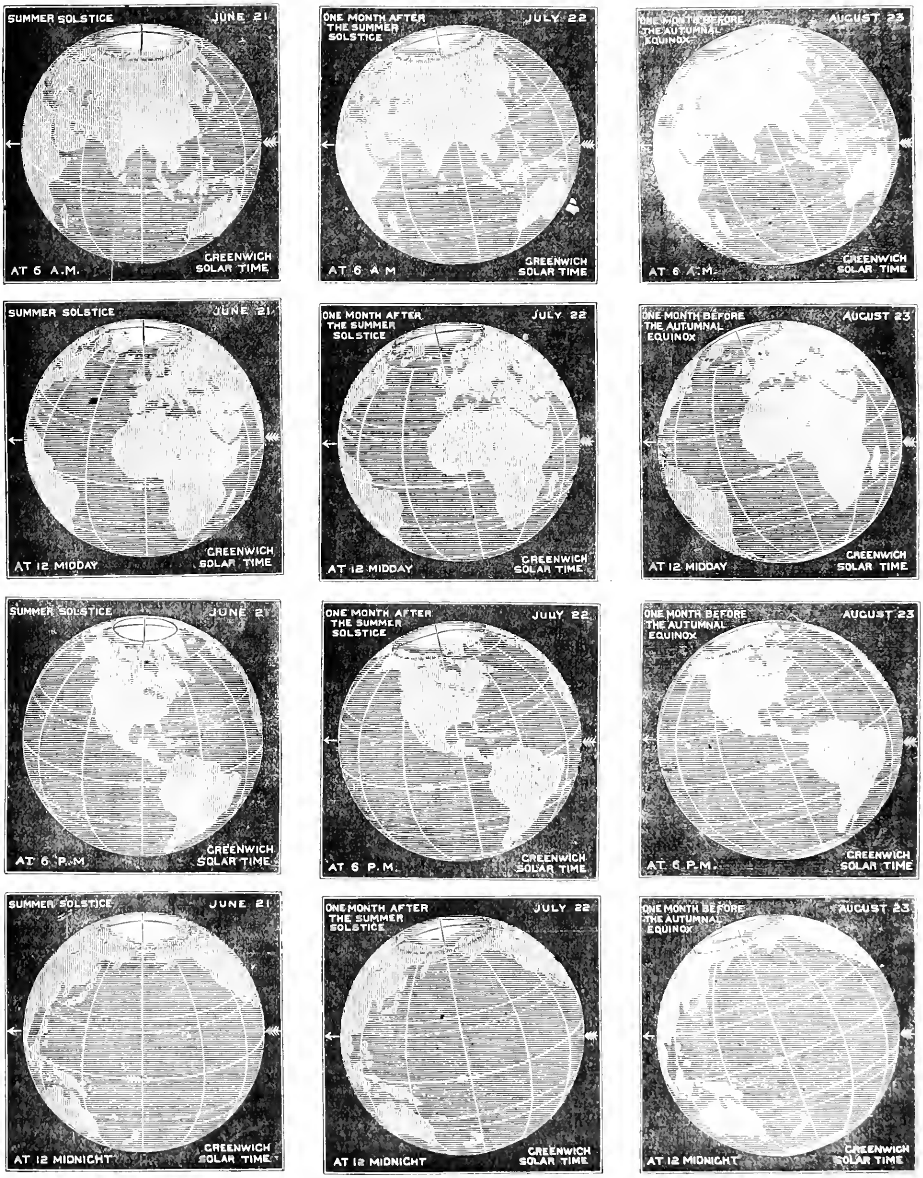
The first step in bread-making is to secure some means of causing the dough to rise, that is to render it porous by the production within it of gaseous carbon dioxide. It has been already explained how the gluten in wheat flour enables it to produce a highly elastic dough, and thus to retain the vesicular structure resulting from the generation within it of gaseous bubbles. It is here that our knowledge of the constituents of grains becomes useful. If moist flour be exposed to the air, the nitrogenous matter quickly passes into a state of decomposition, and acquires the power of rapidly changing the starch of flour not only into dextrin and sugar, but still further into carbon dioxide and alcohol. This second change is termed "fermentation," and is now definitely ascertained to depend on the presence and growth of certain living organisms in the moistened mass. The sporules or seeds of these bodies are floating about in the air, and dropping on to the moistened flour, develop and multiply, and effect this remarkable decomposition of sugar. Although fermentation plays so important a part in the making of bread, yet it is a far more important element in the production of beer and other liquors from malt. When dealing with them, fermentation can best be considered and explained. The moist flour which has acquired this property is termed "leaven," and, when added to a larger quantity of dough, causes fermentation of the whole mass. The carbon dioxide distends the dough by the production of bubbles, the alcohol is evaporated off during the baking of the bread. The production of alcohol and carbon dioxide by the decomposition of sugar is shown by the following equation:—

$$\underset{\text{Sugar.}}{C_6H_{12}O_6} = \underset{\text{Alcohol.}}{2C_2H_6O} + \underset{\text{Carbon Dioxide.}}{2CO_2}$$

Our next article will continue to deal with the chemistry of bread-making.

We are glad to be able to announce that after three weeks of enforced rest the editor of KNOWLEDGE hopes to begin lecturing again (at Eastbourne and Hawkhurst) next week, not at once returning to full work, but hoping gradually to resume his usual working habits. He begs that correspondents will bear with him if there have been delays or omissions. Like the man of whom Mark Twain's correspondent wrote so touchingly, he has "done his level best."

Summer Solstice. One Month after Summer Solstice. One Month before Autumnal Equinox.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week our Sun Views for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight, Greenwich solar time, one month before the autumnal equinox. For comparison, the Sun Views for June and July are repeated.

THE MOON IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

THE light of the rising sun continues to creep over the lunar disc, and we are rapidly approaching her eastern limb; in other words, she is now entering that phase denominated full in the almanacs, when the whole of her surface which is turned towards the earth is simultaneously visible. For reasons before stated, however (Vol. II. p. 222), this is the very worst aspect under which details can be examined, or even identified, and we shall, therefore, describe the leading formations which still remain to be spoken of, as they appear when tolerably near the terminator. And here we may note that ring-plains and mountains situated on, or very near, the actual visible limb of the moon, are seen in a much more natural manner by the terrestrial observer than those more centrally placed on her disc; since they are, of course, looked at much more sideways; like our own mountain ranges as we view them from the surface of the earth. The student will be struck with this if he will go carefully round the eastern (and especially the north-eastern) limb of the moon within a day or two of her being full. It is time, however, that we began our examination of such individual objects as offer points of peculiar interest. Beginning from the south, we shall be struck with the Dörfel mountains (246 in our Map, Vol. II., p. 223), seen in profile on the actual limb of the moon. The three most conspicuous peaks of this tremendous range are believed to exceed 26,000 feet in height. The highest mountain in the world, Mount Everest, in the Himalayas, is 29,000 feet in altitude, but did this bear the same proportion to the earth's diameter that the Dorfel mountains do to the moon's, then would it be 106,079 feet, or more than twenty miles in perpendicular height. In this neighbourhood Phocylides (242) may be looked at as a considerable walled plain, with a flat interior. We, however, mention it here chiefly as a guide to that curious object, Wargentin (243), which looks like an extremely truncated column, some 54 miles in diameter. Webb aptly compares this to "a large, thin cheese." When the moon is eleven or twelve days old, Schickard (239), an enormous walled plain, will repay scrutiny. From north to south this measures some 134 miles, and is nearly as broad, though, of course, it is considerably foreshortened as we view it. The interior is very nearly level, but a three-inch telescope will show the diversity of shade which characterises it. Mersenius (231) is a fine ring plain more than 41 miles across, and contains various small hills, craterlets, &c., quite beyond the power of our instrument. What will strike the young observer is the aspect of its floor, which is convex, like a watch-glass. Just as Fracastorius (372) appears as a bay bounding the southern extremity of the Sea of Nectar (Vol. II., p. 294), so does Letronne (224), formed by the mountains extending from Gassendi, appear at one extremity of the Sea of Storms (Q.) The huge dark plain Grimaldi (272) is nearly 148 miles long by 129 broad, and would have ranked as a "sea" had it been situated near the centre of the moon, instead of close to her limb. Grimaldi is even darker than Plato, and, as we have previously remarked (Vol. II., p. 265,) may often be seen on the dark limb of the moon when illuminated by earthshine. Riccioli (273) is another enormous walled plain, and is very nearly as dark in parts as Grimaldi itself. Just to the south-east of these two last-named formations lie the Lunar Cordilleras (274,) and the D'Alembert Mountains (275), What is probably a portion of this latter chain re-appears as the Rook Mountains (276). Rather further south along the limb, when the moon is nearly thirteen days old, the series of ring plains, Lohrmann (153), Hevelius (154), and Cavalerius (155), offer an interesting spectacle. Hevelius has a convex interior, but by no means so regular as that of Mersenius or does the convexity fill the enclosed area in the same way. Leaving the moon's limb now for the Ocean of Storms we arrive at the most brilliant spot on the whole surface, Aristarchus (148), of which we have spoken before (Vol. II., p. 265), as conspicuous on the dark limb when the moon is young. We had a curious illustration of the extreme brightness of this formation on the occasion in which the subjoined drawing was made (the night of the 15th instant).

Aristarchus and Herodotus. Moon's age 12·86 days.

Huge, black, cumulus clouds were driving at intervals across the sky, and several times when the moon was absolutely blotted out from view in the field of the telescope, Aristarchus continued to shine like a small ill-defined planet. It is difficult or impossible to reproduce this extraordinary lustre in a wood-engraving; it is actually unpleasant to the eye even in a three-inch telescope. The diameter of Aristarchus is twenty-eight miles, and its walls are terraced—albeit the terracing is seen with considerable difficulty, owing to the glare. It has a concave interior with a central mountain—if possible even more brilliant than the internal walls themselves. Its eastern wall extends into a table-land by which it is connected with Herodotus (149). This last-named formation is less than twenty-four miles across, and is very notably darker than Aristarchus. The chief object of interest in connection with Herodotus is the curious serpentine valley or cleft which originates in it, and which was well seen when our sketch was made. Schmidt asserts that this is 1,663 feet deep in places. It enters Herodotus at a point concealed by shadow at the epoch of our drawing.

With this will terminate our description of the moon's surface. As we began by saying, we are not writing a treatise on Selenography, and our object has merely been to invite the attention of the beginner to certain typical Lunar formations, which can be observed with the instrument which has been employed for the purpose of these papers. Our map will in itself supply the student with ample work for a considerable period, inasmuch as it will enable him to identify four hundred of the principal formations on the face of the moon. The possessor of a telescope whom we may have succeeded in interesting in the study of Lunar detail will probably procure Neison's great book on "The Moon," a work containing more detailed information with reference to Selenography proper than any one extant in the English language.

One of the series of descriptive papers of double stars observable with our instrumental means was crowded out at the time by Editorial exigences. It will now appear, and be followed by others on the Sun in a three-inch telescope, and the daylight planets, Mercury and Venus, as viewed with equivalent optical power. In completing these, we shall hope to have furnished the amateur with a

trustworthy guide to the very numerous celestial objects of beauty and interest which are well within the reach of a by no means costly instrument. As a means of perennial amusement and gratification, scarcely anything affords such a return for money laid out as a telescope; and in our survey of the heavens now drawing to a close, we shall have done what we can to show how it may be made to do so.

THE FISHERIES EXHIBITION.

By John Ernest Ady.

V.

To understand the structure of the sponges in general our best plan would be to trace the life-history of some typical form from its embryonic origin to the adult condition. But this is a matter which is involved in the greatest difficulty, because there are, so to speak, many typical forms, which, so far as they have been studied, present wide differences from one another. Then there are other well-known examples, such as the common fresh-water sponge, which present phases of development now considered to be aberrant.

We are thus driven to the necessity of taking an hypothetical case, and, in following its growth, we shall point out the deviations which lead to the several types which occur in nature.

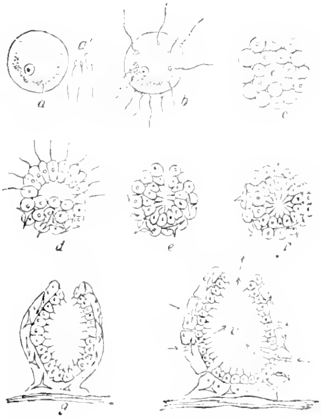


Fig. 11.—Diagrams of the Development of a Sponge: *a*, ovum and *a'*, spermatozoa; *b*, fertilisation of ovum by spermatozoa; *c*, resultant morula, with blastocœle *c'*; *d*, one pole of the embryo ciliated, the other end spiculigerous; *e*, the ciliated pole invaginated into the non-ciliated part; *f*, aperture of embryo closed, showing epiblast with spicules, and hypoblast with cilia surrounding a blastocœle; *g*, the stage *f* fixes itself to a foreign object, and develops an aperture or osculum at the other end; the epiblast fuses into a syncytium, and the hypoblast becomes converted into the endoderm; *h*, the young sponge now develops inhalent pores, which place its ventriculus (*v*) in communication with the exterior. The arrows indicate the course of the currents of water which flow in at these pores, and escape from the exhalent aperture or osculum. (*Original.*)

It is now an all but universally acknowledged fact that, as Martin Barry first pointed out,* cells do not arise *de novo*, as was long ago supposed, but derive their existence from pre-existing cells. To pass backwards in this inquiry,

* Phil. Trans., Royal Society, London, 1838-9.

and to ask for an explanation of the ultimate origin of the living cell, and the nature of life, would be equivalent to an entry into the domain of *meta*physical speculation, which we, as *physical* beings, must altogether decline.

We therefore start with certain cells of the adult sponge which become modified at particular periods into rounded masses bounded externally by a firm portion, and containing what is termed a nucleus and a nucleolus within. The whole cell thus formed separates from the parent organism, and is called an *ovum* or female element (Fig. 11, *a*). In yet other cells of the adult sponge, the protoplasm breaks up into small particles, which upon maturity emerge from the so-called *mother cell of evolution*, and acquire peculiar whip-like tails (Fig. 11, *a'*) and clear hyaline heads; these are the *spermatozoa*, or male elements. Ere long, the spermatozoa penetrate the ovum (Fig. 11, *b*), and become absorbed in some mysterious manner. After this *fertilisation* the ovum undergoes peculiar changes; its nucleus (germinal vesicle) and nucleolus (germinal spot) become obscured, and its protoplasm breaks up by repeated division into a mass of nucleated cells, termed a mulberry mass, or, technically, a *morula* (Fig. 11, *c*), within which there is a cavity or *blastocœle*. One half of this mass of cells produce *cilia* (Fig. 11, *d*) or lash-like processes, and by means of these the little embryo swims about. After a time the ciliated cells become tucked (or invaginated) into the other part, somewhat after the fashion of the drawing-in of the tip of a glove-finger, and the stage now arrived at (Fig. 11, *e*) has been termed by Haeckel the *gastrula* stage. Now, it is a curious fact, according to that distinguished observer, that certain sponges (*Gastrophysema*, *Haliphysema*) get no farther than this stage, which (the gastrula) is also a strong argument in favour of the classification of the sponges amongst the cœlenterate animals, instead of with the lowlier unicellular creatures which are classed together as *Protozoa*. Indeed, so very important is this phase of existence amongst animals, that it forms the line of distinction between the *Protozoa* and all the higher groups, which have, on that account been called, collectively, *Metazoa*.

It was a theory of Haeckel's that the mulberry mass of cells (Fig. 11, *c*), formed a central cavity by an internal splitting or delamination, and that an external aperture afterwards appeared to complete the gastrula stage; but the researches of Metschnikoff,* corroborated by F. E. Schulze, have led him† to abandon that aspect of the case, and to agree generally with what has been sketched above, which is an abstract of Metschnikoff's views.

The gastrula now consists of two layers of cells (Fig. 11, *e*), an external layer (epiblast) and an internal layer (hypoblast); within these there is the primitive cavity or *blastocœle*. The mouth now closes (Fig. 11, *f*), and the outer layer of cells gradually becomes fused to form a membrane in which the individual cells cannot be readily distinguished; and in this *syncytium* the skeletal elements begin to be formed. The embryo has now passed into the condition of a young sponge; it fixes itself by one end to some foreign object, and develops an aperture or *osculum* at the other extremity (Fig. 11, *g*). Next, the cells of the body wall separate at irregular intervals to form pores (Fig. 11, *h*) which can be extemporised at any part of the body, or which may as readily be effaced; and thus a simple sponge is the result, which resembles the adult organism in every essential particular.

* "Zur Entwickelungsgeschichte der Kalkschwämme, Zeits. für wiss. Zoologie," Bd. xxiv.

† "Die Gastrula und die Eifurchung der Thiere." p. 158.

The ciliated cells of the interior of the body cavity, now called a *ventriculus*, draw in water through the pores or inhalent apertures, and the currents are discharged through the large osculum (Fig. 11, *h*). In this way food is brought to every part of the animal organisation suspended in the water. The currents, of course, are produced by the lashing of the cilia within.

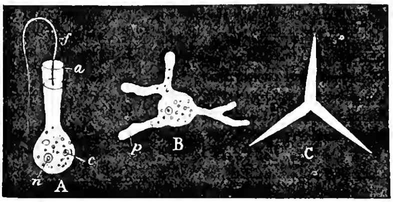


Fig. 12.—*Grantia compressa*, a calcareous sponge. A. Flagellate monadiform cell; *f*, flagellum; *a*, collar; *c*, contractile vacuole; *n*, nucleus. B. Amœboid cell; *p*, pseudopodium. C. Triradiate spicule. (After Carter.)

If now we analyse the body microscopically in detail, we find that the ciliated cells, or, as they are now called, *endodermal* cells, are provided with a collar-like armature, from the centre of which the cilium projects, and that the entire cell, when isolated (Fig. 12, A), bears a strong resemblance to some of the collared monads amongst the flagellated *Infusoria*. It is said that when these cells are fed with coloured particles, such as carmine or Bismarck brown,* the material enters between the cilium and the collar, and thence finds its way into the body of the cell. The outer layer of cells, now denominated the *ectoderm*, which, as we have already stated, becomes fused into a syncytium, is seen to be made up of little particles resembling *Amœbæ* (Fig. 12, B), provided with nuclei and contracting vesicles. Lieberkühn has stated that whilst they seem to be completely fused, they are not so in reality, because, in the case of *Spongilla*, he separated the cells most readily by applying a heat just sufficient to cause protoplasmic coagulation. But this is no argument in favour of their being independent organisms merely associated together, because such a heat would probably be sufficient to dissolve the interstitial cement which held the cells together. Besides, it is a fact well-known to all histological workers, that almost every tissue is capable of dissociation by means of heat, chemical reagents, or ferments; so that the theory of mere coherence through vitality here must fall to the ground. The cells of the sponge, however, are largely endowed with an independent existence; thus, if two *Spongillæ* are brought together, they gradually coalesce to form a single sponge; or, conversely, if a living sponge is cut into pieces, each piece so detached is capable of living and growing. In fact, these occurrences have been taken advantage of by Dr. Oscar Schmidt in his experiments on sponge life, and are now being widely adopted in the commercial fisheries of the Adriatic.

The ectodermal cells of the adult sponge are also said to be capable of ingesting food by themselves; but it is more probable that they derive their nutriment secondarily through the pabulum collected by the endodermic cells.

When a sponge such as that just described developes spicules of an organic material impregnated with carbonate of lime, the spicules are usually tri-radiate (Fig. 12, C), and the sponge is called a calcareous sponge. The *Ascetta primordialis* of Haeckel is a simple form of sponge of this kind; in it we find a flask-shaped body turned upside-down, the neck of the flask is fixed to the substratum, whilst its base remains patent as the osculum. Its walls are composed of only two layers of cells, the ectoderm and endoderm; and in the former, which is in form of a syncytium, the tri-radiate spicules of carbonate of lime are scattered. These spicules are concentrically deposited, and form a firm basis upon which the superstructure is supported. Some of the endodermal cells become converted into the mother cells of the spermatozoa; whilst other cells of either layer are changed into ova, and thus we are brought to the commencement of the cycle of changes described.

* It is best to use Bismarck brown or Vesuvin, as the living organisms become stained without being killed. Carmine usually paralyses delicate organisms.—J. E. A.

Messrs. R. Clay, Sons, & Taylor, of Bread-street Hill, E.C., have purchased the *Pictorial World*, with the intention of carrying it on under such new and improved arrangements as are likely to secure the success which its present large circulation and popularity ought to put beyond a doubt.

Thunderstorm.—Telegrams from Geneva, dated the 15th inst., speak of a very violent thunderstorm as having occurred in the Jura on the morning of that date. Several houses are reported to have been struck, and villages set on fire, whilst the telegraphic and telephonic service was deranged. The centre of the storm seems to have been about Neuchâtel, where for some twenty minutes the sky is reported to have been in a continual blaze.

Telephone Wires and the Public.—On Saturday week, in the City of London Court, before Mr. Commissioner Kerr, an application was made by Mr. G. Kebbell, solicitor, Seething-lane, on behalf of Mr. German, the freeholder of land at Bow, for an order by way of injunction restraining the United Telephone Company and directing them to remove certain posts which they had erected on his property, as well as the wires suspended therefrom. The proceedings, as given in the daily press, were somewhat amusing, as will be seen from the following report:—Mr. Scott, barrister, for the defendant company, contended that they had obtained leave from the lessees of certain parts of the land to erect the posts. Mr. Kebbell denied this, and said that the posts were really placed on the plaintiff's land, over which the lessees had a right of way, and that the wires were beyond doubt suspended across the land in question, which was unoccupied. Mr. Scott: Your Honour knows that it has become a custom for telephone companies to place their wires from house to house, and few people object, as it is a matter of public convenience. His Honour: That cannot give the companies a right to put their wires across any man's land. The law is that an owner is entitled to the enjoyment of everything between his land and the heavens. Why does not the plaintiff cut the wires? Mr. Kebbell: That is just the difficulty. We are afraid that if we did so the wires would fall on other people's land and endanger life. His Honour: But you would not be liable to a charge of manslaughter. Mr. Kebbell: Without discussing my client's legal position, I could not allow him to take a course by which life might be imperilled. His Honour: No doubt. The matter had better stand over till the hearing, and I promise that you shall not be prejudiced by the delay. The case was accordingly adjourned.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

LIGHT FROM FLOWERS.

[900]—Under the head of "Singular Phenomenon" [882] in Knowledge of July 27, which I happened not to see till two days ago, your correspondent S. Ingham has revived, in a very pleasant way, the recollections of my early years; for I have been for more than half a century acquainted with the occasional notices of this strange appearance which are given in the books of the day, or in older works, and have frequently watched for it, though always unsuccessfully; while in modern times it seems to have passed into undeserved oblivion. As far as I recollect, it was always mentioned as connected with red, and perhaps yellow, flowers—for the marigold was, I think, associated with the geranium; and it was said to be visible in the dusk, and in warm weather. The only book referring to it on which I can now lay my hand is Forster's "Perennial Calendar" (1824), where, under the heading of May 21, is the following not very satisfactory description :—"Among atmospheric phenomena to be noticed at this time of year, we may mention pale lambent light of an electric sort, which plays of an evening in fine weather about the leaves of plants, and of which an account will be found in Forster's 'Atmospheric Phenomena,' third edition, and in the journal subjoined to that work, under May 21, 1808." To the book thus referred to, I have no access at present, but probably some of the readers of Knowledge may be more fortunate, and may be induced to give us the benefit of a search; in fact the subject is so curious and inexplicable, that it well deserves a closer and more extended investigation, the results of which, with the Editor's kind permission, might appear in these pages. It may be feared that the most favourable season for observation is past, but from Mr. Ingham's letter it is evidently not confined to the spring. In the meantime, as we have so little account of details, I would suggest the following points as deserving of attention :—the character of the light—whether a general haze, or a defined brush or spark; its persistency, or the frequency of its emission; its brightness; length; direction (horizontal or otherwise); colour; and how far it is affected by the presence of the finger or any other body introduced into the region which it occupies. It may be observed that this strange phenomenon has no connection with the sudden and rapid combustion of volatile oil, which may be produced by the application of flame to the stems of the fraxinella while in blossom a curious experiment which I have repeatedly tried, and which is of a far more intelligible nature. T. W. Webb.

WART-CHARMING.

[901]—My father, the Rev. John Webb, who died in the year 1869, aged nearly 93 years, possessed this curious power in a remarkable degree. I have heard him describe the way in which, when a young man, he became conscious of it, from touching, for mere amusement, a wart on a child's eyelid with a finger moistened from his tongue, and saying that it would go away. Great was his surprise, as well as that of others, to find that his prediction was soon verified. After that time he exercised this power whenever opportunities presented themselves, and with great success. On one occasion, as he was passing on horseback through a turnpike-gate, he noticed that the arm of a woman who was washing there was covered with warts, which were bleeding from the nature of her work. He touched them and passed on. The next time he saw her, he found they were all gone, though such an inflammation had attended their departure that she thought she should have lost her arm. I have, from time to time, exercised the same power with success. On one occasion I gave the little daughter of a friend, whose hand was much troubled with these excrescences, a small bottle of water tinted with some colour, desiring that each wart should be touched with the wetted cork; this, however, having failed to produce any effect, I made her give me her hand through a nearly-closed door, her back being turned at the same time, and slightly pricked each wart with the point of a penknife. This was followed by their entire disappearance. My impression is that, provided the patient has confidence in the process, anything that affects the imagination sufficiently will produce the result—so surprising and so little understood is the connection between the body and the mind. Truly, we are "fearfully and wonderfully made!"

T. W. Webb.

GNAT POISON.—WART-CHARMING.

[902]—As a subscriber to your valuable periodical from the start, permit me to offer this communication. Speaking of Aphides in your last issue, Mr. Henry J. Slack thus writes :—"It is supposed that to facilitate a flow of the plant's juices, they pour in a poisonous fluid as gnats do into our bodies." Now, it so happens that very many years ago, and long before I ever hear of the theory that the poison of mosquitoes facilitated their deglutition of blood, I made the following experiments in the West Indies. 1. I permitted one to settle on the back of my hand and insert her proboscis (of which process I should have been unaware had I not been observing it), and then put a stop to her greediness by a slap from the other hand. No poisoning ensued, nor any other perceptible effect. 2. I permitted others to draw blood to various extent short of repletion, killed them in like manner, and the result was the same. 3. I then suffered others to gorge themselves and fly away, and was invariabl poisoned. I wondered at the time at this kindly provision of nature, and though a generation has since passed away, I wonder no less still.

Many years ago a son of mine had a number of warts on his hands, and was told by a countryman that he could get rid of them by cutting a sod in a certain way, rubbing the warts with the under side of it, and then hiding it while no one was looking on. The result being entirely satisfactory, a sister of his then tried the recipe, but it failed completely. My own experience is this—as long as I was at a boarding-school I was troubled with many, and used various applications to get rid of them, but after I had been at home for about three months they all went away of themselves; change of diet, in this case, evidently effecting the cure.

Accept my congratulations on the success of Knowledge; also on the able way in which you have dealt with certain parties whose mental faculties are evidently polarised, and believe me, yours faithfully, An M.D. of Forty Years' Standing.

May 21, 1883.

MAGIC SQUARES.

[903]—G. S. has sent you (888, Vol. IV., p. 61) "a very complete magic square," which combines most of the properties claimed (233, Vol. I., p. 271) for Snart's "climax to odd squares," with others to be found in Corn. Agrippa's talismanic square (depicted in the 3rd figure, Vol. I., p. 100). Now, first as to Mr. Miles' climax with Snart's square. Bachet never published a square of 49 cells; but his principle applies to the formation of Agrippa's square (2nd figure, Vol. I., p. 100). This has not the 24 ways of reading 175 about the centre which Snart's square has, nor the other two noticed. But Agrippa's square is so perfectly magical that we get 175 on summing up the parallel lines made through 22, 48, 18, 37, 14, 33, 4; 5, 24, 43, 20, 39, 9, 35; 30, 7, 26, &c., in all 7; so through 22, 27, 12, 7, 44, 39, 34; 5, 49, 37, 32, 27, 10; 30, 25, 20, 8, 3, 47, 12, &c., in all 7; so through 22, 42, 6, &c.; 5, 18, 31, &c.; 30, 43, 14, &c., in all 7; so through 22, 11, 49, &c.; 5, 36, 25, &c., in all 7; 22, 29, 36, &c.; 5, 12, 19, &c., another 7. Thus there are 35 ways; or, going upwards, there are 7 of the series, 22, 40, 2, 20, &c., and of 22, 9, 45, &c., of 22, 34, 39, &c., 22, 3, 33, &c.—or 28 more, for 22, 28, 27, &c., are already reckoned.

Next, as to G. S.'s "very complete square." Agrippa's square of 81 cells has not the 24 ways of making 369 about the centre as in G. S.'s square. But there are 9 series parallel to 37, 30, 23, 16, 9, 74, 67, 60, 53; 9 parallel to 37, 71, 15, 40, &c.; 9 parallel to 37, 63, 80, 16, &c.; 9 parallel with 37, 43, 72, &c. These yield 36 ways, and there are many other ways of getting the same result; besides the centre square of nine cells totals 365, and is also magical.

The adjoining square of 81 cells has not the 21 variations exhibited in G. S.'s square, but it has all its other properties, with the addition of 360 other ways of obtaining a summation equivalent to

a side, by taking three consecutive numbers in each of three lesser squares of nine cells, horizontally or vertically, exclusive of his, which must include the centre cell. There are 62 more variations taking one or other of the two diagonals in each small square in combination with one or other of the diagonals in two other smaller squares. Numerous other variations may be made combining three contiguous numbers in each of three smaller squares: thus, three numbers, taken horizontally in one, vertically in another, and diagonally in the third,—35, 28, 33, with 20, 25, 24, and 65, 68, 71; or 12, 14, 16, with 40, 39, 44, and 67, 68, 69, without any reference to the centre cell. Again, the whole square is "tessellated," *i.e.*, is made up of nine lesser squres of nine cells each, each lesser square taken separately being itself a magic square.

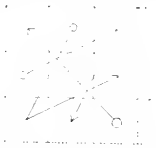
31	36	29	76	81	74	13	18	11
30	32	34	75	77	79	12	14	16
35	28	33	80	73	78	17	10	15
22	27	20	40	45	38	58	63	56
21	23	25	39	41	43	57	59	61
26	19	24	44	37	42	62	55	60
67	72	65	4	9	2	49	54	47
66	68	70	3	5	7	48	50	52
71	64	69	8	1	6	53	46	51

4 9 2

7 3

8

G. S. concludes by remarking that a very little investigation will show the principle upon which his figure is constructed. I question whether this will satisfy most of your readers. My construction is simple. The eight small square is Agrippa's model for all his odd squares. The mean of the progressive numbers is put in the centre, the first term below and the last above the centre. If n represent the number of cells in a side, then the whole series is divided into batches of n terms. The first batch, commencing with 1, is placed in order downwards and diagonally.



On a number of this batch leaving the bottom of the square, it is transferred to a corresponding square at the top, vertically above; should it run out on the right side, it is transferred to the corresponding horizontal cell on the left hand side. The first of the second batch is placed two cells below the last term of the first batch, and the diagonal system continued. Should the first or any other of this batch fall without the square, it is brought in as before explained. The first term of the third batch is placed two cells below the last of the second, and so on. Thus the eighth square was formed. The other squares are arranged in accordance with it. The whole series, through 1, 2, 3 . . . . . to 79, 80, 81, is divided into nine sets, 1, 2, 3, &c., 9; 10, 11, &c., 18; 19, 20, &c., 27, &c. The first set is placed in the square corresponding with the cell in the small square represented by 1, *i.e.*, middle of bottom row. The next set is put in the square corresponding with 2, *i.e.*, the right upper corner, and so on. What Agrippa calls the seal or character of this square (dedicated to Saturn) is really the direction in which their numbers are placed, as in figure. J. O. M.

CURIOUS STRUCTURE IN THE SQUIRREL.

[904]—After removing the skin of a common squirrel, I was struck by observing two thin flaps of muscular tissue extending from the superior part of the fore-arms to the region of the floating ribs; this flap formed part of the muscle of the back, and was open to the front and connected with the intercostal muscles by some fine, tendonous threads. The flaps were partly distended when the creature was lying on its back and immersed in water, and were capable of sufficient distension to allow three of my fingers to be placed in the hollow formed. Not having noticed such a construction in other animals, I wondered whether it was the rudiment of the wing (so to speak) of the flying squirrel, which I am disposed to think it is. It might be described as a huge armpit.

GEO. COMBE WILLIAMS.

[Mr. Williams's interesting letter was sent in May, but unfortunately was mislaid.—R.P.]

PARCEL POST PROBLEM.

[905]—*Determine the shape and cubic contents of the largest package which can be sent by the parcel post, supposing the length of a cylinder or solid of any other form to be the maximum distance in a straight line between any two points on its surface.*

The shape of the parcel must be that of the volume common to a sphere and a right circular cylinder, the axis of which passes through the centre of the sphere. Let x = radius of sphere
y = radius of cylinder.

$$\text{Then volume common to both} = \frac{4\pi}{3} \cdot \left\{x^3 - (x^2 - y^2)^{\frac{3}{2}}\right\}$$

$$\text{and } 2x + 2\pi y = 6$$

$$\therefore\ x^3 - (x^2 - y^2)^{\frac{3}{2}} = \text{a maximum.}$$

Eliminating dx, dy from the differentials of these equations, we get

$$\pi\,(x^2 - x\sqrt{x^2 - y^2}) = y\sqrt{x^2 - y^2}$$

or dividing by y^2, putting $\frac{x}{y} = z$, and reducing

$$z^3 - \frac{\pi^2 - 1}{2\pi} z^2 - z - \frac{1}{2\pi} = 0$$

$$3x^2 - 3x\sqrt{x^2 - y^2} + 3y\frac{dy}{dx}\sqrt{x^2 - y^2} = 0$$

$$\frac{dy}{dx} = \frac{1}{\pi}$$

Putting for π its value, and solving the equation (which has only one real root), we get

$$z = \frac{x}{y} = 1{\cdot}9625$$

$$\text{also } x + \pi y = 3$$

Whence length of parcel $= 2x = 2{\cdot}307$ feet.
" girth " $= 2\pi y = 3{\cdot}693$ do.

$$\text{Contents} = \frac{4\pi}{3} \cdot \left\{x^3 - (x^2 - y^2)^{\frac{3}{2}}\right\} = 2{\cdot}333 \text{ cubic feet.}$$

$= 2\frac{1}{3}$ do. H. F.

[H. F. also sends the correct solution of the problem dealt with at p. 76.—R. P.]

LETTERS RECEIVED, AND SHORT ANSWERS.

A. W. Should not care to publish such wonders till I had seen them myself, and tested pretty closely.—MINNIE. Saturn is in Taurus.—J. D. VdS. Fear I can only offer you the Paradox Column; but I would point out, in a note, where your trisection of any angle by simple geometry was invalid, or for what reason it failed to solve the insoluble.—A. T. FRASER. Prefer not to open a vexed and vexing question.—A LADY MATHEMATICIAN. "Mad Tom" was joking, of course. Non-Euclidean mathematics may be described as mathematics based on axioms inconsistent with our conceptions. A new arithmetic might equally well (as indeed Clifford, Helmholtz, and others suggested) be based on the axiom that 2 and 2 make three, which in some universe unknown to us, they may do. But we may wait before we give time to such new arithmetic or geometry until the unknown universe to which they belong begins to loom above our intellectual horizon.—G. G. CHISHOLM. Cannot say; but have great difficulty in finding space for all which I should like to give in these columns.—W. H. B. RANNIE. Quite impossible to bring out the Star Maps again in KNOWLEDGE—it would be unfair to a great number of our readers, who have already had these Star Maps. The great bulk of our first subscribers must (so far as can be judged) be with us still.—JAS. E. RATTLE, M. MOLYNEUX, D. E. H. R., RENFREW, GRAVESEND DOCTOR, and others. Think it best to insert no more prescriptions for Cholera patients.—JAS. J. HILL. The problem is insoluble in that form, the velocity of a running stream depending on other matters than the fall.—BANK. The star atlas you mention must be imperfect if it fails to show you to what part of the star sphere the earth's axis points, southwards. There is no conspicuous star there, but the place is in the constellation Octans, shown in the middle of the twelfth map of my School Atlas.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By Richard A. Proctor.

PART XIII.

LET us consider the method applied in our last. One condition shows us that the point we seek *must* lie on a certain curve; another condition shows us that the point *must* lie on another curve. Therefore, the point we seek must lie at some intersection of the two curves. If there are more intersections than one, the problem has more solutions than one; if there is but one intersection, there is but one solution; if, lastly, the curves do not intersect, the problem is insoluble.

Let us take, as another instance, the following problem:—

Ex. 20.—*Let A B (Fig. 30) be a given straight line, C a given angle, D a given point within the given circle E F G. It is required to determine a point at which A B shall subtend an angle equal to the angle C, and which (point) shall be the bisection of a chord through D to the circle E F G.*

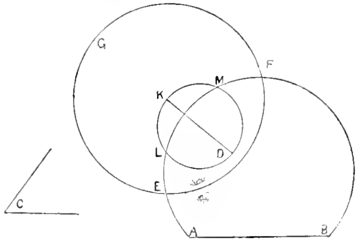


Fig. 30.

In order that A B may subtend an angle equal to C at the required point, this point must lie, we find (as in Ex. 17), on the arc A E B, containing an angle equal to the Angle C.

Again, in order that the required point may be the bisection of a chord through D to the circle E F G, this point must lie, we find (as in Ex. 18), on the circle L K M, which has for diameter the line joining D with K the centre of the circle E F G.

These two loci—viz., the arc A E B and the circle L M K, determine by their intersection the points which satisfy the required conditions. There may be two points, as in the case illustrated by our figure; or one point, if the circle L M K *touch* the arc A E B; or the two loci may not intersect, in which case the problem does not admit of solution.

We have supposed that the point is required to lie above A B. If not, then an arc equal in all respects to A E B, but applied on the opposite side of A B, would include other points satisfying the first condition of our problem. It might happen that the circle L M K intersected the latter arc, instead of, or as well as, the arc A E B. Such point or points of intersection would also supply a solution of the problem.

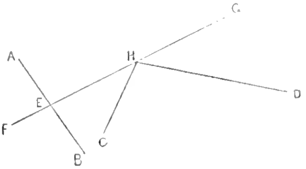


Fig. 31.

Problems in maxima and minima also involve very frequently the discussion of loci.

Suppose, for instance, that the following problem is given:—

Ex. 21.—*A, B, C, and D (Fig. 31) are four fixed points. It is required to determine a point equidistant from A and B, and such that the sum of its distances from C and D shall be a minimum.*

In this case we first find the locus of points equidistant from A and B. This, as in Ex. 18, is the line F G drawn at right angles to the line A B, through its bisection E, Fig. 31. We have, then, to find a point in F G such that the sum of its distances from C and D may be a minimum. We find (as in Ex. 11) that the point must be so taken—as at H—that the lines from C and D to it shall make equal angles (C H F and D H G) with the line F G.

To take another simple instance, suppose we had the following problem:—

Ex. 22.—*A triangle is constructed on a given base A B (Fig. 32), and with a vertical angle equal to the angle C, to determine its figure that its area may be a maximum.*

Here we first inquire what is the locus of the vertices of all the triangles which can be constructed on the base A B with a vertical angle equal to the angle C. We find, as in Ex. 17, that the locus is the arc A D B, containing an angle equal to the angle C.

After this we can find no difficulty in determining the triangle of maximum area. The vertex must clearly lie at that point of the arc A D B which is farthest from A B; and D, the bisection of the arc, is obviously the required vertex. The student will at once see this; but perhaps he may find a little difficulty in proving it. We leave this part of the problem to him as an exercise, having already

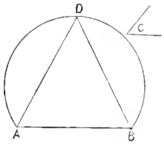


Fig. 32.

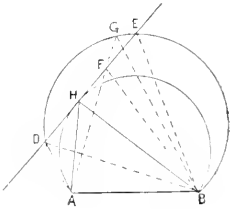


Fig. 33.

examined the treatment of problems of this class. We note, however, that what he has to do is to show that a parallel to A B through D is farther from A B than the parallel through a vertex of any other triangle fulfilling the required conditions; and this will be established if it be shown that the parallel to A B through D is a tangent to the arc A D B.

Sometimes a familiarity with the treatment of problems on loci, serves us in a somewhat more subtle manner, as in the following problem:—

Ex. 23.—*A B (Fig. 33) is a given finite straight line. It is required to show where a point must be taken in the given indefinite line D E, in order that the angle subtended by A B from the point may be a maximum.*

Suppose we take any point, D, at random, in D E, and draw the lines D A and D B. Then, in inquiring whether the angle A D B is a maximum or not, it would be an obvious consideration that the segment of a circle, A D E B, described on A B, contains all the points from which A B subtends an angle equal to the angle A D B. From the point E, therefore, A B subtends an angle, A E B, equal to the angle A D B; and from any point, F, between D and E, it is clear that A B subtends an angle greater than A D B. For, producing A F to meet the arc A D B in G, and joining G B, we see that A F B is greater than A G B (Euc. I., 16), that is than A D B (Euc. III., 27). It is clear, therefore, that we cannot have a maximum so long as the arc described on A B, to pass through the particular point selected in D E, cuts D E in another point. Hence we arrive immediately at the solution of our problem—viz., that the required point, H, is so situated that the arc on A B through H touches the straight line D E.

It is easy to draw a circle through two given points to touch a given straight line. But, strictly speaking, the solution of the above problem is complete without the construction of the circle A H B, since we have assigned a sufficient condition for the determination of the required point in D E.

The consideration of problems on loci leads us to another class or rather two classes of deductions—viz., those in which it is required to prove either that certain straight lines pass through one point, or that certain points (more than two) lie in a straight line.

(*To be continued.*)

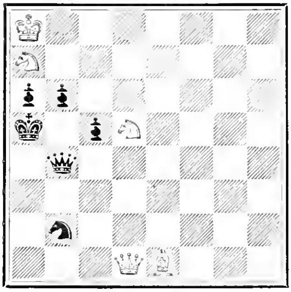
Our Chess Column.

By Mephisto.

PROBLEM No. 93.

By Leonard P. Rees.

Black.



White.

White to play and mate in two moves.

A FINE GAME PLAYED AT NÜRENBERG IN THE SECOND TOURNAMENT BY HERR TARASCH, THE FIRST PRIZE WINNER, IN THE FINAL HEAT OF THE WINNERS.

FRENCH DEFENCE.

White. Herr Tarasch.	Black. Herr v. Schere.	White. Herr Tarasch.	Black. Herr v. Schere.
1. P to K4	P to K3	16. B to B5	B to Kt3
2. P to Q4	P to Q4	17. B tks QKt (*d*)	Kt takes B
3. QKt to B3	B to Kt5 (*a*)	18. Kt takes Kt	Q takes Kt
4. P takes P	P takes P	19. P to B5	B to R2
5. Kt to B3	KKt to B3	20. P to B6	B to Kt3 (*e*)
6. B to Q3	Castles	21. R to B2	QR to K sq
7. Castles	B to Kt5	22. QR to KB sq	R to K5
8. B to KKt5	B takes QKt	23. B to Kt3 (*f*)	K to R2
9. P takes B	QKt to Q2	24. P takes P	K takes P
10. Q to Q2 (*b*)	P to B3	25. B to B4	K to R2 (*g*)
11. Kt to K5	Q to B2	26. B takes P	R to KKt sq
12. P to KB4	P to KR3	27. B to Kt5	Q to K3
13. B to R4	P to B4 (*c*)	28. B to B6 (*h*)	R to K6
14. P to KR3	B to R4	29. R to Kt2 (*i*)	R takes P
15. P to Kt4	P to B5	30. R to B3	R to R3
		White mates in five.	

NOTES.

(*a*) Not commendable. In most close games the B is necessary for the defence of the K side on K2 or Q3.

(*b*) Showing good judgment. If Black now captures the Kt, White would get the open Kt file for his R, which in conjunction with the two B's would soon become dangerous to Black.

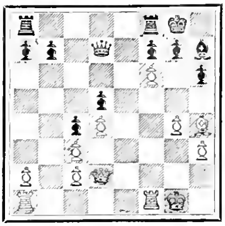
(*c*) Black has his B in a very uncomfortable position; the move in the text does not help him in any way; his only other alternative seems to be Kt takes Kt, which would turn out satisfactorily if BP retook, but White would obtain a superiority as follows:—Kt takes Kt. 14. QP takes Kt, Kt to R2 (Kt to K5 is bad, as after B takes Kt, and P takes B, the Black P on K5 would soon fall). 15. P to B5 (threatening to win the B), P to B3. 16. P to K6, with a good position.

(*d*) White is playing a spirited game. He prefers to continue a doubtful attack to winning a clear P by Kt takes B, and remaining with two B's against two Kt's.

(*e*) P to Kt4 would be bad on account of 21. B takes P, P takes B. 22. Q takes P (ch), B to Kt3. 23. Q to R6. The likely-looking move of B to K5 would result in loss of time, as the B is required for the defence of the BP, *i.e.*, B to K5. 21. P takes P, K takes P. 22. R to B6, R to R sq. 23. QR to KB sq, QR to KB sq. 24. Q to B4, R to R2 (to avoid the threatened loss of the exchange by R to Q6). 25. R to Q6, Q to K sq (as otherwise, B to K7). 26. B to B6 (ch), K to Kt sq. 27. R to Q8, Q to K3. 28. Q to Kt8, and wins.

Position after White's 20th move, P to B6.

Black.



White.

(*f*) To avoid any possible sacrifice of the R for the two P's and the B, and to make the B available for attack.

(*g*) The P cannot be defended by R to KR sq, on account of B to K5 (ch).

(*h*) With the object of playing Q to Kt5.

(*i*) Very fine play indeed, which brings about a forced termination of the game. White threatened to reach the R file *viâ* B2, which Black could not prevent without loss.

(*j*) The ending forms a termination quite worthy of the first prize winner, and is as follows:—31. Q takes R (ch), K takes R. 32. R to R2 (ch), B to R4. 33. R takes B (ch), K to Kt3. 34. R to Kt5 (ch), K to R2. 35. R to R3, mate.

SOLUTIONS.

Problem No. 90, p. 96.

1. Kt to Kt7	K takes R		R takes R
2. Kt to Kt4!	K to K4	Q to R5 (ch)	K to K5
3. Kt to B6, mate.		Kt to B5, mate.	
	Or, 2. R to K5		
3. Q to B3, mate.			

Problem No. 91 we regret to say is incorrect. The author's idea being 1. Kt to B3, R to K4. 2. Q to B4 (ch), B takes Q. 3. Castles, mate. Black can, however, frustrate this artful design by playing 1. R to Q5.

ANSWERS TO CORRESPONDENTS.

**** Please address Chess Editor.*

J. Berger Graz.—Games and problems received; our best thanks for same.

Chess Editor, *Times Democrat*.—We have complied with your request, and hope to be favoured in return.

Leonard P. Rees.—Accept our best thanks for friendly expressions. Problem received with thanks. We hope you will have success in forming an association of the Surrey Chess Clubs. It seems strange that what is possible in Germany—a National Association—should not be attempted in England. The surest road to that end is to form counties associations. You will no doubt have the support of all Surrey players.

Joseph Farrar.—Solution of No. 92 correct.

E. N. Parker.—You evidently did not read Note (*j*) to the game p. 112. It contains the desired information.

B. Hammond.—Problem 92. If K to K7, then P to B4.

W.—Solutions correct. Very sorry you spent so much time over 91. Did you guess the idea?

SPECIAL NOTICES.

Part XXI (July, 1883), just ready, price 10d., post-free, 1s. 1d.

Volume III., comprising the numbers published from January to June, 1883, just ready, price 7s. 6d.

Contents of No. 94.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 31, 1883.

CONTENTS OF No. 96.

A NATURALIST'S YEAR.

By GRANT ALLEN.

XX.—WILD PEAS.

AMONG the hedgerows here, on the side of a deep Surrey lane, the lithe curling stems of the common English yellow pea clamber in their usual straggling fashion over the loose outlying sprays of bramble and hawthorn bushes. Looking close into the hedge, you can see that they festoon themselves by means of their tight-twisted tendrils, which wind and insinuate their graceful coils round and round the successive supports by whose aid they struggle gradually upward towards the air and light. Strange as it sounds to say so, these thin spiral tendrils are in reality metamorphosed leaves, or perhaps one ought rather to put it, the abortive footstalks of undeveloped leaflets. Pull off one of the whole leaves from the stem, and you will see it consists of a central midrib or common leaf-stalk, with two little arrow-headed stipules at its base, and one pair of very narrow leaflets half-way up; but the end of the leaf-stalk bears no more leaflets, and in their place it ends in a branched tendril, which really represents the altered and modified remnant of the remaining blades. See here, by the side of the yellow peas I have picked for comparison, two other leaves belonging to the same peaflower tribe; one is the pretty purple-tufted vetch (*Vicia cracca*), a common wayside plant over all Britain; the other is the bright golden Hippocrepis, abundant in chalky pastures and on limestone banks in Southern England. You will observe that the tufted vetch has several pairs of leaflets to each leaf, arranged in couples on opposite sides of the common stalk, instead of one pair only, as in the yellow pea; but at the end, it terminates in a branched tendril of much the same character as that of its yellow ally; while in the Hippocrepis each leaf-stalk, besides bearing some four or eight pairs of lateral leaflets, ends also in a single terminal leaflet, which occupies the place taken by the tendril both in the tufted vetch and in the yellow pea. These two cases help us to understand the line of development by which the leaflets at the end of the stalk in the most clambering species of peaflowers have been gradually metamorphosed into twining tendrils. If we take a rapid glance at the general type of foliage in the entire family, and at the special modifications which that type undergoes in adaptation to the varying environments of diverse divergent forms, we shall still better understand the nature and origin of these peculiar elongated leaf-organs.

The original and central peaflower leaf, from which all the other leaves of the group are derived by suppression or alteration of particular features, consists of a long central leaf-stalk, terminating in a single leaflet, and with other similar leaflets arranged in pairs down the opposite sides. This form of leaf is very well seen in Hippocrepis; and among other English plants of the family which exhibit it equally well, I may mention the pretty little bird's-foot (*Ornithopus perpusillus*), the common lady's-fingers (*Anthyllis vulneraria*), and the beautiful pale pink sainfoin (*Onobrychis sativa*), if not indigenous, at least now fully naturalised in the southern and eastern counties. That this long pinnate type of leaf is the original one we can gather both from the ease with which all the other forms can be derived from it, from their occasional relapse into it, and from the fact that it also appears in some of the simplest roses, of which the peaflowers are genetically a slightly specialised offshoot. This central type of leaf occurs mainly in those peaflowers which grow in open ground, where all the blade is freely exposed to air and sunlight.

The easiest variation upon the central type is found in certain divergent peaflowers, like the clovers, which intermingle freely with the grasses in meadows, and have to compete with them for their fair share of space and sunshine. In these cases the leaflets on the lower part of the leaf-stalk are never developed, because they could do no good to the plant; they would be over-shadowed by the grasses and other tall weeds on every side of them. Hence they would naturally grow smaller and smaller by disuse with each generation; while, at the same time, those plants which showed the greatest tendency to get rid of them, and to produce the three upper leaflets only (the terminal one, and a single pair below it), would be most highly favoured in the struggle for existence, because they wasted none of their material in places where it would be comparatively ineffective. So, in the long run, the clovers have come to possess the familiar trefoil type of leaf, consisting of three broad and expanded leaflets, all equally exposed to the sunshine at the top of their naked and elongated leaf-stalk. The common lotus shows us an intermediate stage between this type and the primitive pinnate form, for in that case there are five leaf lets, three arranged in a trefoil at the end of the stalk, and two broad ones lower down, practically usurping the place and function of the original stipules. Other English peaflowers of the trefoil group are lucerne, nonsuch, and the other Medicagos, besides the rarer Melilotus and Trigonella. Broom is a bushy example of the same sort; but in it the two lateral leaflets are often wanting, and only the terminal one is developed. This last state, well adapted for shrubs and bushes, has become habitual in the English genistas, like petty whin; but some exotic genistas, cultivated in our conservatories, still retain the trefoil type of foliage. Furthest removed of all from the central type on this line of development is the common gorse, where the adult leaves are reduced to mere stiff, simple prickles; but even in this instance we have some faint memorial left of the earlier habit; for, as I have pointed out here already, the young seedling gorse plants have trefoil leaves, which only gradually merge as the shrub grows older, first into long, thin leafy, blades, and finally into sharp and rounded bristles.

On the opposite line of development, towards the peas and vetches, we get this system of suppression among the leaflets exactly reversed. The climbing types get rid, not of the lowest, but of the terminal leaflets; and for this very

good reason, that they want to use the ends of their leaf-stalks as tendrils to fasten them firmly on their unwilling hosts. The vetches are not quite such highly-developed plants as the true peas, and they supply us accordingly with some very interesting gradations in this direction. There is one rather uncommon British form (*Vicia orobus*), remarkable for its stem being more erect and its habit less climbing than in other vetches; and this form has a terminal leaflet to all the upper leaves, though in the lower ones the common leaf-stalk ends instead in a very rudimentary tendril, represented merely by a short point. In another slightly more advanced type (*Vicia tetrasperma*) there is always present a terminal tendril instead of the last leaflet; and sometimes this tendril is branched, that is to say in other words, a pair of lateral leaflets have also been reduced to naked twining leaf-stalks. In our other vetches, the tendrils are almost always branched, and one very developed type (*Vicia bithynica*), confined in Britain to the West Country, has only one pair of leaflets left. Of course, as these two have to do all the work, they have grown comparatively large and long, while in the other vetches, where the leaflets are many, they are usually small and broad. The true peas, forming the genus Lathyrus, show us a still further progress in the same direction. We have one very rare British species (it occurs with us only in Perthshire and Forfarshire, and is everywhere a dying mountain type) which resembles *Vicia orobus* in having a good many leaflets on each leaf, and in the occasional reappearance of the terminal leaflet in the upper foliage. But most of our peas have very few leaflets—indeed sometimes two pairs, and sometimes only one, all the rest being converted into tendrils to aid the climbing habit. At the same time the work of foliage is thrown a good deal on the stipules, which grow out accordingly into large, flat, leaf-like organs, far more conspicuous in the garden pea than the true leaflets, while the common leaf-stalk also shows a tendency to be winged or expanded at the side, which is very noticeable in the "everlasting pea" of our flower-beds and trellises. These two last tendencies find their final outcome in two English wild peas which have no real leaflets at all, having entirely substituted for them these auxiliary foliar organs. One is the so-called yellow vetchling (*Lathyrus aphaca*), a weed of cultivation which appears very occasionally in the cornfields of our southern counties; it has the two stipules immensely enlarged into what looks like a pair of big opposite heart-shaped leaves, with only a slender branching tendril between them to represent the original leaf-stalk and leaflets. The other is the grass-pea (*Lathyrus nissolia*) a pretty, grass-like plant, with beautiful pale-red flowers; it grows among tall grasses on the borders of fields, and has been compelled by its situation to imitate the shape of the surrounding blades, which it does by flattening out the common leaf-stalk into a long narrow ribbon, without stipules, leaflets, or even tendrils, save in the form of a fine point. The everlasting pea, and some south European forms, give us a good idea of the stages by which this curious transformation has been effected. The final result is that the grass-pea looks in foliage almost like a grass or sedge, and does not in any way recall its real ancestry from a highly compound pinnate leaf like that of sainfoin or Hippocrepis.

*** THE picture of the Whirlpool Rapids promised for last number of KNOWLEDGE will appear next week. It presents the Rapids as shown in an instantaneous photograph, taken at a moment when the collision of the water particles, so graphically described by Professor Tyndall, had just taken place.

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.C.S., F.R.M.S.

AMONG the objects mentioned in the last paper as affording beautiful specimens of plant-hairs strengthened by silex, was the cuticle of *Deutzia scabra* leaves. It is not possible to make good preparations of this cuticle by mechanical means, but it is easily effected by chemical agency, and a similar plan is useful in a variety of other cases. A perfectly sound well-grown leaf of *Deutzia scabra* should be cut into pieces about one-third of an inch square, and the thick mid-rib rejected. Pieces of this size will lie at the bottom of a large test-tube, six inches long and one inch wide. If the experimenter is not provided with any apparatus to hold such a tube, one can easily be made by sticking a piece of stout wire eight or nine inches long into a small square block of wood, and bending the top of the wire into a ring just wide enough to hold the tube by its projecting rim. The ring should be turned on one side, so as to keep the tube in a slanting position. This being arranged, pour some nitric acid into the test-tube, so as to cover the bits of leaf and occupy a space of about one inch in height. A spirit-lamp should be held under the tube, and the acid made quite hot. Small crystals of chlorate of potash should then be dropped in, one or two at a time. They excite a brisk effervescence. If added too quickly, or the acid is heated too highly, the mixture swells up suddenly, and may even boil over. This must be avoided, as a violent treatment of the leaf tears the cuticle into minute fragments, and from these no fine slides can be prepared. If the frothing is too slow, a little more heat should be applied, and the dropping in of the chlorate of potash continued until nothing is seen but a collection of white films floating on a bright yellow fluid. The tube must now be allowed to cool, and then with a little dexterity all the yellow fluid can be poured off, and the films allowed to remain. They must be washed several times by filling the tube with plain clear water and pouring it off again. All these things must be done gently, so as not to tear the films.

Those accustomed to chemical operations will not need more instruction, but for beginners further information is necessary. The process is one of oxidising, or burning away, all but the leaf cuticle. The oxygen is applied at the expense of the chlorate of potash and of the nitric acid, and as soon as the action goes on briskly, the latter gives forth orange fumes of nitric-oxide gas.* This is not only very unpleasant, but extremely unwholesome to breathe. A good mouthful of it, even when largely mixed with common air, is very suffocating and highly injurious to the lungs. The fumes should be allowed to go up a chimney or out of window. The operator should notice which way the air-currents carry them, and keep, as sailors say, to the leeward. Beginners should make their first experiment on a smaller scale than has been mentioned. Nitric acid burns holes in clothes and stains the skin yellow. Having completed the process as described, the films may be kept in a small bottle, with a little water and a few drops of alcohol. To prepare a slide, take up a few films on a needle and drop them into a small shallow saucer of clear water; or, if a very small quantity is on the needle, it may be placed on the centre of a glass slide in a water-drop. The first plan is the best, as most certain to remove any chlorate of potash that may not have

* When nitric oxide meets common air, it instantly seizes its oxygen and becomes the orange gas nitrous acid, which is readily absorbed by water and is highly corrosive.

been washed out in the former processes. If the films have lost all their air-bubbles they may not float, but stirring the water will make them do it, and a few small pieces can be fished out with a thin spoon or a knife-blade, and dropped on to a glass slide. They must then be spread out very carefully with fine needles stuck in wooden handles, or a fine sable pencil such as miniature painters use. The object is to get some films spread out quite flat. They will most likely be found folded up, or one over another. The least force tears them, but under a hand-magnifier or a dissecting microscope success is easily obtained. Having arranged a few films nicely in a water-drop, the slide should be allowed to dry slowly where no dust can get at it. When it is quite dry, put a drop of Canada balsam, thinned with benzine, on to a glass cover, and press it gently on to the films. The cover may be held with a spring clip, such as opticians sell for the purpose, and the balsam must be allowed to harden before the slide is fit for use. A hint may be given about the Canada balsam. It is much too thick for most purposes in the state in which it is usually sold. Pure benzine, or benzole, as it is also called, dissolves it readily, so much so that it is very useful in cleaning the superfluous balsam off slides. When used for thinning, it must be added cautiously, and the balsam bottle put in a warm place. When it is about as thick as golden syrup treacle—not quite thin enough for the films—further additions of benzine act rather suddenly, and the thinning may be carried too far. If so, the extra supply can be evaporated; but it is well to hit the right quantity.

Amongst the objects which yield beautiful results with the acid and chlorate of potash treatment are the needle-shaped leaves of the pine-trees. *Pinus Austriaca*, common in shrubberies, is a good one for the purpose. Quite clean leaves should be selected, of fresh growth. They should be cut into short lengths, so as not to require much acid to cover them, and treated exactly as the Deutzia leaves, but they want a little more cooking. When finished they are quite white, and in the state of hollow tubes, all their insides being eaten out. To prepare for the microscope, a piece of the tube must be slit open and flattened out on a slide with fine needles in a drop of water. If it curls up it must be flattened again and kept so by a covering-glass. When quite dry, mount in balsam, and view with a half-inch objective polarised light and a selenite film. A hand-magnifier is sufficient to show that fir needles are ornamented with rows of white glistening spots. In these the stomata of the plant are situated. Their action upon polarised light is very beautiful, and the changes obtainable by rotating the prisms very striking. Very elegant patterns that would be popular for ladies' dresses, window-curtains, &c., readily appear. So far as the writer knows, these pine needles have been generally neglected by microscopists.

TRICYCLES IN 1883.

SMALL WHEELS *v.* LARGE WHEELS.

By John Browning,

Chairman of the London Tricycle Club.

Considerations of space prevented me from exhausting this subject in my last article, though I had left several points of great importance untouched on.

The weight of machines with large wheels is never felt so injuriously as when pushing up hill. It has been roughly calculated that out of each ten miles of road in England one mile, at least, will be a hill too steep to be rideable.

Let any person take a ride of, say, even fifty miles in a day on a tricycle with small wheels, weighing 60 lb., over a moderately hilly road, and then repeat the ride over the same course on a machine with, say, 52-in. wheels, weighing 96 lb. to 98 lb., which is a common weight for such a machine. After pushing this machine up the hills, I will warrant he will have had enough of large wheels.

Last year I rode a "Premier Sociable," with 48-in. wheels. As I wished to drive the machine throughout the day, if I pleased, without my wife once putting her feet on the pedals, I had it geared down to 36 in. The weight of this machine was 172 lb. My pace, when riding with my wife, was about four miles an hour, and our journeys averaged twenty miles a day.

This year I have been riding an "Apollo Sociable" I had specially made for me, with 44-inch wheels geared down to 36 inches, as in the former case, but the weight of this machine is only 133 lb. Our pace on this is improved to five miles an hour, and we average about 30 miles a day with ease, and have ridden 7½ miles within forty minutes, and 23 miles in four hours. These we did easily, though I pushed the machine up more than three miles of hills alone. With the additional experience I have now gained I consider I should have done better by having the "Apollo" made with 36-inch wheels geared level.

I thoroughly disagree with all gearing-down. When a low gearing is required, let the wheels be made small instead, and the rider will have a lighter, stronger, and more compact machine.

Weight is not everything, I admit; but tricyclists must make it the first consideration. It is the principal cause of the exhaustion often complained of by riders. When I rode a single machine which weighed 109 lb., I could only ride fifteen miles without requiring a meal. Now I have a machine which weighs just over 50 lb., I commonly ride twenty-five miles between meals, and I have ridden twenty-nine miles without refreshment.

Regarded as performances these examples are, of course, very poor, but being born almost without muscles, I am compelled to ride with my brains, and my illustrations are none the less useful on that account.

Another point greatly in favour of small wheels is that they offer scarcely any resistance to wind compared to large wheels. I have frequently seen men almost pulled up by wind on machines with 50-in. wheels, while others, who were not stronger riders, were travelling without much difficulty on machines with 40-in. wheels.

The truth is, that I have been advocating the use of small wheels for years with a definite object in view. I wished to see our machines combine the ease of the bicycle with the comfort and safety of a tricycle. To accomplish this, I saw that we must obtain a great reduction in their weight. We cannot dispense with the weight of the third wheel and its friction on the road, but we need have no more. When I began my experiments, tricycles weighed about twice as much as bicycles. I soon found that the greater part of the weight was in the two driving-wheels. It was, therefore, absolutely necessary to reduce the size of these if we wished to make any considerable reduction in the weight of the machine. This can be done without any disadvantage of consequence, because the tricycle, unlike the bicycle, admits of being geared up so that the pedals need not make a greater number of revolutions with the smaller wheels.

The driving-wheels must, of course, revolve oftener let them do so; with ball-bearings the small additional friction may be neglected.

Some strong riders, I know, object to fast pedalling, and prefer to work with greater pressure on their pedals. This

is no argument against small wheels; on the contrary, I consider it is one of the strongest points in favour of them, that the rider may have them geared up to any degree that suits him, still keeping his machine as low in weight as possible.

There have been complaints, I am aware, of machines with small wheels giving a painful amount of vibration; but I have in every such case traced it to another source—namely, that with small wheels the makers have given very small tyres, in the endeavour to make the machine lighter with as little trouble to themselves as possible.

Now, the smaller the wheels and the lighter the machine, the larger the tyres require to be to lessen the vibration, both to the machine and the rider. Small wheels must have tyres at least the same size as are usually put on large wheels, or they will be unfairly tested.

Only one objection that I know of can be urged against small wheels. Some persons dislike their appearance. It is difficult to argue on matters of taste; but I think small wheels look best, because with large wheels the machine predominates over the rider, while with small wheels the man dominates the machine.

THE AMATEUR ELECTRICIAN.

BATTERIES.—IV.

It was observed in the preceding article that the Leclanché cell introduced a great peculiarity in the matter of the negative element and its surroundings. The utility of the battery is so great that several modifications in its construction have been devised. One of them is the "Gravity" Leclanché. It is generally made in troughs of ten cells, each cell being separated from its neighbours by means of slate or other suitable material coated with

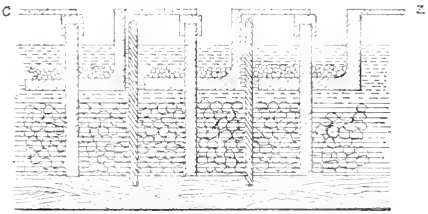


Fig. 1.

marine glue.* Fig. 1 is an illustration of the battery. The zinc plate is of a peculiar shape (as shown in Fig. 2), and is supported by the strap resting on the slate partition. The carbon is in the form of a rectangular rod or block, which, passing through the hole in the zinc plate, dips into a quantity of broken carbon and manganic dioxide. Care must be taken that the carbon black does not touch the zinc. A layer of sal-ammoniac is placed on the zinc plate, and water being added, it is gradually dissolved. A copper strap cast into the plate, and serves to connect it to the carbon in the next cell.

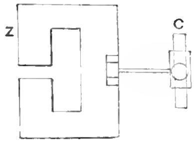


Fig. 2.

The action is, naturally, the same as in the ordinary Leclanché, the advantage gained being a considerable reduction in the resistance consequent on the omission of the porous earthenware pot. The resistance is 1·5 Ohms, the E M F being of course the same as in the ordinary form. Care should be taken not to disturb the battery, nor should it be forgotten that it is advisable, if not absolutely necessary, to leave the lid of the trough (should it have one) slightly raised, to permit any free ammonia that may be given off to escape. As is the case with all batteries, cleanliness is essential. The salt (sal ammoniac) has a strong tendency to crystallise, but a damp cloth passed over the edges of the cells occasionally will suffice to prevent this.

Another modification, having for its object the omission of the porous pot, but free from the difficulties attending the use of the gravity form, is that known as the "Agglomerate." This, too, has several varieties. It will be sufficient if we confine ourselves to two of them. In the first, the negative element consists of a plate or flat block of carbon placed between two blocks of compressed manganic peroxide. India-rubber bands keep the three blocks in contact, the porous pot being thereby dispensed with.

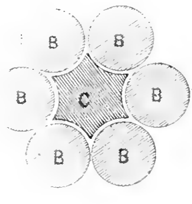


Fig. 3.

The form which has met with greater favour is, however, of a somewhat different shape. Fig. 3 is a horizontal section of the negative element which consists of a fluted block of carbon (*c*), having a circular rod of compressed manganic peroxide (B) in each of the six flutes. A piece of coarse canvas passed round and secured by a couple of elastic bands keeps the parts together. In the previously-described agglomerate cell the ordinary zinc rod is generally used, but in this one zinc cylinders are used, the result being a very considerable reduction in resistance and greater constancy on circuits of high resistance. The resistance is but 0·1 of an Ohm, while as a demonstration of its greater constancy it may be mentioned that a battery of forty agglomerate cells has for a long time past been employed on one of the busiest London and Liverpool telegraph wires. It is also worthy of notice that no less than 2,000 of these cells are at present in use at the

* Marine glue is a substance insoluble in water and acids, but readily soluble in carbonic disulphide (CS_2). Originally it was composed of caoutchouc dissolved in naphtha and shellac, but the cost of the ingredients is too high for general purposes, and the material now known as marine glue is made from less costly constituents. It acquires a treacley subsistency on gently heating, and cools very rapidly. For such purposes as it is usually employed by amateurs it may be worked with little difficulty. It may be heated in an old iron ladle over a gentle fire, and then poured out as required; or small pieces of it may be laid on the substance to be coated, and an old file or other piece of iron, heated to a dull red, passed over it, but not allowed to touch it until the heat is considerably reduced. An even layer may be very easily made in this way. Some complain that they cannot work the glue, but where this is the case it can only be through downright clumsiness.

Central Telegraph Office in London. Were the resistance of the circuit low, polarization would speedily ensue. Nevertheless, the agglomerate cell is to be preferred to the ordinary Leclanché, even for amateur purposes. The blocks are very durable, and after nearly two years' hard service show little or no signs of giving way.

It is still an open question whether the agglomerate cells have any advantage over the parent form, other than is derived from the absence of the porous pot and the increased zinc surface. Consequently an excellent form is that known as the Grénet, in which the porous pot is replaced by a stitched canvas bag to hold the manganic peroxide and carbon. In this instance all the gain pertaining to the agglomerate is embraced.

The Bennett cell is in principle somewhat akin to the Leclanché, but for general work is not to be compared with it. The positive element is a piece of zinc immersed in a solution of caustic soda, a compound which has the merit of being not only inexpensive but equally nasty. A porous cell containing the soda solution is stood in a tin, or rather tinned-iron, can, the space between the can and the porous pot being filled with iron turnings. The solution gradually penetrates the porous pot, and, damping the turnings, a circuit is formed and a current generated. This current is, however, very spasmodic, and even less constant than that from the Leclanché. It can, therefore, found no great claim on its efficiency, while on the other hand it enjoys the privilege pertaining to all batteries containing iron, of perfuming the air with sulphuretted hydrogen—an odour which, if it is like anything on this earth, resembles most strongly the delicious aroma of rotten eggs. When the cell was first introduced, accompanied as it was with loud and general acclamations, it was recommended as being extremely cheap in construction, the outer or containing vessel being an old preserved meat-can. We noticed, however, that those sent out by the company which enjoyed the privilege of selling it, were contained in specially made tins, having a closely-fitting cover, presumably to bottle up the scent. It is manifest from what we have said concerning the cell that it is impossible for us to recommend its adoption for any purpose whatever.

We shall next turn our attention to a large class of batteries, embraced under the generic appellation of "Bichromate," and amongst them we hope to see some of exceptional utility to the student.

LAWS OF BRIGHTNESS.

IX.

By Richard A. Proctor.

It remains only that I should consider the effect of instrumental appliances for increasing the degree of light which we receive from objects.

The telescope is an appliance of this sort; in fact, we may regard as the main feature of the telescope its power as a light-gatherer. In whatever proportion the object-glass of a refractor, or the mirror of a reflector, exceeds in area the pupil of the eye, in the same proportion (neglecting loss of light by imperfect reflection, or through refraction) may the quantity of light received by the eye when the telescope is used exceed the quantity received from the same object when the eye is unaided. I say *may* rather than *does*; for matters may be so arranged that the full light-gathering power of the telescope is not employed.

Now, it seems at first sight that in consequence of this relation the apparent brightness of an object observed with a large telescope must be enormously increased. And, as I mentioned in the first paper of this series, the idea seems monstrous to many that there cannot under any circumstances be an increase of apparent brightness of an object, though there may be an enormous increase in the total quantity of light received from the object. "Do you mean to tell me," an esteemed friend of mine once remarked, "that the moon is no brighter with my $6\frac{1}{2}$ in. reflector than with the naked eye? It *must* be brighter. I can scarcely bear to look at the moon, it is so bright, when I use a low power and the moon is high up in a clear sky; but I have never found any trouble in looking at the moon with the naked eye." Be it understood that there was no question as to the point under discussion. It was the intrinsic lustre of the moon's surface, not the total quantity of light received from her, that we were both considering. I pointed out, though I am bound to admit the argument was not found to be convincing, that there is the same intrinsic degree of pain when one tooth is pulled out as if a dozen were extracted at once, yet a man might easily bear one operation who would faint under the other.*

But as a matter of fact the case of the telescope is exceedingly simple. Take, for convenience, the simplest form of the astronomical telescope, which gives the brightest images for a given magnifying power. Let $O\,O'$ (Fig. 14) be the object-glass, $e\,e'$ the eye-glass; and let a pencil filling the whole object-glass converge to a focus at F, and after falling on the part $n\,n'$ of the eye-glass emerge with parallel rays and fall on the pupil of the eye E. Its cross-section is either just equal in diameter to the pupil of the eye, or less, or greater. First suppose it equal. Then the total quantity of light received from the point of the image, exceeds the quantity which would fall on the pupil of the naked eye as $(O\,O')^2$ exceeds $(n\,n')^2$. But the magnifying power of the telescope is represented by the ratio

$$\frac{O\,F}{F\,n}, \quad \text{or, which is the same ratio,} \quad \frac{O\,O'}{n\,n'}$$

Therefore the apparent area of the object is increased in the ratio $(O\,O')^2$ to $(n\,n')^2$—the precise ratio in which the total quantity of light received from the object is increased. This increase, then, is just competent to make the increased area as bright as the area seen by the unaided eye.

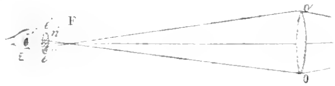


Fig. 14.

But next suppose $n\,n'$ less than the diameter of the pupil, and call this diameter d. Then, as the whole of the emergent pencil falls on the pupil, the increase of the total quantity of light is as $O\,O'^2$ to d^2, but the magnifying power of the telescope is, as before, $\frac{O\,O'}{n\,n'}$, and the magnification of areas is as $O\,O'^2$ to $(n\,n')^2$. Thus the magnification of areas is to the total increase of light as

$$\frac{(O\,O')^2}{(n\,n')^2} : \frac{(O\,O')^2}{d^2}$$

or as

$$d^2 : (n\,n')^2.$$

But d is greater than $n\,n'$; hence the apparent area of

* I suppose this to be the case, but do not speak from experience. I have heard, however, that even a man of the strongest frame would be shaken if a dozen teeth were extracted in quick succession; and I presume the extraction of a dozen at the same instant would be even more trying. By extraction, I mean fair deliberate lugging out, such as the soul of the dentist loveth—not knocking out by a blow; though the knocking out of a dozen teeth at once can hardly be a pleasant experience.

the object is increased in a greater proportion than the light. Therefore the apparent brightness of the object is diminished.

Lastly, let us suppose $n n'$ greater than d. Then the magnification of areas is, as before, represented by the ratio $\frac{(O O')^2}{(n n')^2}$; and the increase in the quantity of the light falling on the eye is as $(O O')^2$ to d^2; but this quantity does not enter the pupil, because it comes out in a pencil of parallel rays having a cross-section of diameter $n n'$, and the pupil has only a cross-section of diameter d; the proportion entering the eye is thus reduced in the proportion of the areas of these cross-sections, or as d^2 to $(n n')^2$. Hence the quantity of light actually received by the pupil is represented by the proportion

$$\frac{(O O')^2}{d^2} \cdot \frac{d^2}{(n n')^2}, \text{ or } \frac{(O O')^2}{(n n')^2},$$

which is the proportion in which the apparent area of the object is increased. Hence the brightness remains unchanged, as in the first case. The only difference, in fact, between this case and the first is that the telescope is not in the last case pushed to the full power it will bear without a reduction in the apparent brightness of objects: in fact, only a portion of the object-glass is really used in bringing light to the eye from any point of the object. Light from each point of an object, in such a case as this, employs (as it were) its own part (a circular part) of the object-glass.*

Of course, the above reasoning does not apply in the case of a star, because a star is *not* apparently magnified by a telescope; but on the contrary, owing to the operation of laws with which we are not at present concerned, the image is reduced. Thus, the brightness of a star is increased pretty nearly in proportion to the area of the object-glass or mirror.

But even in the case of stars the law above considered has its analogue. Take an imaginary case, where (say) twenty stars form a cluster (each star being visible to the naked eye) and the telescope shows those twenty stars and no more; then, the apparent brightness of the cluster, regarded as a whole, remains unaltered when the telescope is used; for in precise proportion to the increase in the brightness of the individual stars is the increase in the apparent area of the cluster.†

The application to the planets, moon, sun, &c., is obvious.

It may be asked why night-glasses show objects which the unaided eye cannot see; and again why, by the use of single magnifying glasses we can read at dusk what would be undiscernible, or only discerned with difficulty, by the naked eye. The answer simply is that the quantity of light received from the object is increased. It is easy to test this.

Let the observer look at the page of a book with a magnifying glass in the dusk of evening, and notice whether the part seen with the glass (and rendered legible by its means) seems a brighter circular spot on the darker ground of the rest of the page, or *vice versâ*. If he is careful not to let the diffused light from the glass reach his eye, he will see at once that the legible part of the page looks darker than the part outside, which nevertheless is illegible.

It is equally clear, but the point requires to be more carefully dwelt upon, that we cannot by increasing the size of telescopes increase the apparent brightness of such objects as nebulæ, comets, the zodiacal light, &c. In the case of very large objects like the zodiacal light we cannot even increase the total quantity of light received by the eye. In the case of comets, nebulæ, &c., we can do so; and so we can render objects of this sort discernible, or even conspicuous, which otherwise would remain unseen. But it is important to notice that we cannot increase their brightness. It is this which constitutes one of the great difficulties in applying the spectroscopic analysis of these objects; for in such analysis it is often convenient to use a rather narrow slit, and therefore the spectroscopist cannot avail himself of the great quantity of light gathered up for him by his telescope. Some astronomers, therefore, in examining the nebulæ which give three or four bright-line spectra, use an open slit, or no slit at all, getting three or four *images* of the nebula, instead of three or four lines.

In another kind of research—the study, namely, of those faint but widely extending nebulosities which Sir W. Herschel was the first to notice—a large telescope is of no great use. I am persuaded, indeed, that the naked eye can do more in work of this sort than is commonly supposed, care being taken to protect the eye from extraneous light, and also to conceal the lucid stars from view.

* The case corresponds to that of an opera-glass (for it is easily seen that the reasoning would not be affected by substituting a Galilean for a simple astronomical telescope). Accordingly it will be found that in using an opera-glass we can hide or dim a portion of the field of view by covering a part of the object-glass. But in the case of a telescope used (as the astronomical nearly always is) with its full power, covering a part of the object-glass dims the whole field equally. Dr. Huggins told me, six or seven years ago, of an old telescope he bought, in which the object-glass was four or five inches in diameter, and the focal length little more than a foot. The emergent pencil was an inch or so in diameter (with the power actually employed). As Dr. Huggins quaintly remarked, it was "a telescope for a horse, not for a man."

† In passing, I may notice that the same law applies to the effects of distance. A cluster of stars, separately discernible, would remain just as bright regarded as a whole (that is, not considering the total quantity of light received from it, but its brightness as related to its area), however far it might be removed, so long as the separate stars continued discernible. Nor would it grow any brighter, as a whole, however near it might approach to the observer. (It is assumed here for the moment, that there is no extinction of light in the interstellar spaces.)

Autumn Leaves.—Messrs. Sampson Low, Marston, & Co. are issuing for the autumn holidays a new edition of Mr. F. G. Heath's "Autumnal Leaves"—a work which the author claims to be the only one ever published in Europe or America giving actual facsimile representations in colour and venation of autumn-tinted foliage.

A Carbonaceous Meteorite.—An interesting meteorite which fell in the province of Entre-Rios, Argentine Republic, has been examined by M. Daubrée. The meteorite recalls certain kinds of lignite and clay coals, such as the boghead coal. In the black paste of the meteorite are to be seen small angular grains of a bottle-green of a hyaline colour, others again are whitish. The whole appearance of the stone resembles some of our volcanic conglomerates. Brass-yellow grains like pyrrhotine are also visible, and reddish spots like the chloride of iron sometimes seen in meteorites. Chemical analysis shows that the meteorite contains iron, lime, and magnesia. The most important peculiarity of the meteorite is, however, that it contains carbon in an organic form. This is chiefly proved by the action of potash on it. In fact, Dr. Daubrée hopes yet to find a meteorite bearing organic remains. Other carbonaceous meteorites have fallen in divers places, but none, so far as we are aware, have yielded traces of organic life.—*Engineering.*

THE CHEMISTRY OF COOKERY.

XVII.

By W. Mattieu Williams.

FRYING IN OIL.

REGARDING the fat used in frying as a medium for conveying heat, freedom from any special flavour of its own is a primary desideratum. Olive oil of the best quality is almost absolutely tasteless, and having as high a boiling point as animal fats it is the best of all frying media. In this country there is a prejudice against the use of such oil. I have noticed at some of those humble, but most useful establishments where poor people are supplied with penny or twopenny portions of good fish, better cooked than in the majority of "eligible villa residences" that in the front is an inscription stating "only the best beef-dripping is used in this establishment." This means a repudiation of oil. Such oil as has been supplied for fish-frying may well be repudiated.

On my first visit to Arctic Norway I arrived before the garnering and exportation of the spring cod harvest was completed. The packet stopped at a score or so of stations on the Lofodens and the mainland. Foggy weather was no impediment, as an experienced pilot free from catarrh could steer direct to the harbour by "following his nose." Huge cauldrons stood by the shore in which were stewing the last batches of the livers of cod fish caught a month before and exposed in the meantime to the continuous arctic sunshine. Their condition must be imagined, as I abstain from description of details. The business then proceeding was the extraction of the oil from these livers. It is, of course, "cod liver oil," but is known commercially as "fish oil," or "cod oil." That which is sold by our druggists as cod liver oil is described in Norway as "medicine oil," and though prepared from the same raw material, is extracted in a different manner. Only fresh livers are used for this, and the best quality, the "cold-drawn" oil, is obtained by pressing the livers without stewing. Those who are unfortunately familiar with this carefully prepared, highly refined, product, know that the fishy flavour clings to it so pertinaciously that all attempts to completely remove it without decomposing the oil have failed. This being the case, it is easily understood that the fish oil stewed so crudely out of the putrid or semi-putrid livers must be nauseous indeed. I am told that it has nevertheless been used by some of the fish fryers, and I know that refuse "Gallipoli" (olive oil of the worst quality) is sold for this purpose. The oil obtained in the course of salting sardines, herrings, &c., has also been used.

Such being the case, it is not surprising that the use of oil for frying should, like the oil itself, be in bad odour.

I dwell upon this because we are probably on what, if a fine writer, I should call the "eve of a great revolution" in respect to frying media.

Two new materials, pure, tasteless, and so cheap as to be capable of pushing pig-fat (lard) out of the market, have recently been introduced. These are cotton-seed oil and poppy-seed oil. The first has been for some time in the market offered for sale under various fictitious names, which I will not reveal, as I refuse to become a medium for the advertisement of anything—however good in itself—that is sold under false pretences. If the lamp of Knowledge, more fortunate than that of Diogenes, should light upon some honest men who will retail cotton-seed oil as cotton-seed oil, I shall gladly (with the Editor's permission) do a little straightforward touting for them, as they will be public benefactors, greatly aiding the present movement for the extension of the use of fish food.

As every bale of cotton yields half a ton of seed, and every ton of seed may be made to yield 28 lb. to 32 lb. of crude oil, the available quantity is very great. At present only a small quantity is made, the surplus seed being used as manure. Its fertilising value would not be diminished by removing the oil, which is only a hydro-carbon, *i.e.*, material supplied by air and water. All the fertilising constituents of the seed are left behind in the oil-cake from which the oil has been pressed.

Hitherto cotton-seed oil has fallen among thieves. It is used as an adulterant of olive oil; sardines and pilchards are packed in it. The sardine trade has declined lately, some say from deficient supplies of the fish. I suspect that there has been a decline in the demand due to the substitution of this oil for that of the olive. Many people who formerly enjoyed sardines no longer care for them, and they do not know why. The substitution of cotton-seed oil explains this in most cases. It is not rancid, has no decided flavour, but still is unpleasant when eaten raw, as with salads or sardines. It has a flat, cold character, and an aftertaste that is faintly suggestive of castor oil; but faint as it is, it interferes with the demand for a purely luxurious article of food. This delicate defect is quite inappreciable in the results of its use as a frying medium. The very best lard or ordinary kitchen butter, eaten cold, has more ob jectionable flavour than refined cotton-seed oil.

I have not tasted poppy-seed oil, but am told that it is similar to that from the cotton-seed. As regards the quantities available, some idea may be formed by plucking a ripe head from a garden poppy and shaking out the little round seeds through the windows on the top. Those who have not tried this will be astonished at the numbers produced by each flower. As poppies are largely cultivated for the production of opium, and the yield of the drug itself by each plant is very small, the supplies of oil may be considerable; 571,542 cwt. of seeds were exported from India last year, of which 346,031 cwt. went to France.

Palm oil, though at present practically unknown in the kitchen, may easily become an esteemed material for the frying kettle (I say "kettle," as the ordinary English frying pan is only fit for the cooking of such things as barley bannocks, pancakes, fladbrod, or oat cakes). At present, the familiar uses of palm-oil in candle-making and for railway grease will cause my suggestion to shock the nerves of many delicate people, but these should remember that before palm-oil was imported at all, the material from which candles and soap were made, and by which cart-wheels and heavy machinery were greased, was tallow—*i.e.*, the fat of mutton and beef. The reason why our grandmothers did not use candles when short of dripping or suet was that the mutton fat constituting the candle was impure, so are the yellow candles and yellow grease in the axle-boxes of the railway carriages. This vegetable fat is quite as inoffensive in itself, quite as wholesome, and—sentimentally regarded—less objectionable, than the fat obtained from the carcase of a slaughtered animal.

When common-sense and true sentiment supplant mere unreasoning prejudice, vegetable oils and vegetable fats will largely supplant those of animal origin in every element of our dietary. We are but just beginning to understand them. Chevreul, who was the first to teach us the chemistry of fats, is still living, and we are only learning how to make butter (not "inferior Dorset," but "choice Normandy") without the aid of dairy produce. There is, therefore, good reason for anticipating that the inexhaustible supplies of oil obtainable from the vegetable world—especially from tropical vegetation—will ere long

be freely available for kitchen uses, and the now popular product of the Chicago hog factories will be altogether banished therefrom, and used only for greasing cart-wheels and other machinery.

As a practical conclusion of this part of my subject, I will quote from this month's number of *The Oil Trade Review* the current wholesale prices of some of the oils possibly available for frying purposes. *Olive oil*, from £43 to £90 per tun of 252 gallons; *Cod oil* £36 per tun; *Sardine or train* (*i.e.* the oil that drains from pilchards, herrings, sardines, &c., when salted) £27. 10s. to £28 per tun. *Cocoanut* from £35 to £38 per ton of 20 cwt. (This in the case of oil is nearly the same as the measured tun.) *Palm* from £38 to £40. 10s. per ton; *Palm-nut or copra*, £31. 10s. per ton; *Refined cotton seed*, £30. 10s. to £31 per ton; *Lard*, £53 to £55 per ton. The above are the extreme ranges of each class. I have not copied the technical names and prices of the intermediate varieties. One penny per lb. is = £9. 6s. 8d. per ton, or in round numbers, £1 per ton may be reckoned as 1-9th of a penny per lb. Thus the present price of best refined cotton-seed oil is 3½d. per lb.; of cocoanut oil, 3¾d.; palm-oil, from 3½d. to 4½d., while lard costs 6d. per lb. wholesale—usually 7d.

I should add in reference to the seed-oils, that there is a possible objection to their use as frying media. Oils extracted from seeds contain more or less of *linoleine* (so-named from its abundance in linseed oil), which, when exposed to the air, combines with oxygen, swells and dries. If the oil from cotton-seed or poppy-seed contains too much of this, it will thicken inconveniently when kept for a length of time exposed to the air. Palm-oil is practically free from it, but I am doubtful respecting palm-nut-oil, as most of the nut-oils are "driers."

EVOLUTION OF HUMAN PHYSIOGNOMY.*

By E. D. Cope.

THE ability to read character in the form of the human face and figure, is a gift possessed by comparatively few persons, although most people interpret, more or less correctly, the salient points of human expression. The transient appearances of the face reveal temporary phases of feeling which are common to all men; but the constant qualities of the mind should be expressed, if at all, in the permanent forms of the executive instrument of the mind, the body. To detect the peculiarities of the mind by external marks, has been the aim of the physiognomist of all times; but it is only in the light of modern evolutionary science that much progress in this direction can be made. The mind, as a function of part of the body, partakes of its perfections and its defects, and exhibits parallel types of development. Every peculiarity of the body has probably some corresponding significance in the mind; and the causes of the former, are the remoter causes of the latter. Hence, before a true physiognomy can be attempted, the origin of the features of the face and general form must be known. Not that a perfect physiognomy will ever be possible. A mental constitution so complex as that of man cannot be expected to exhibit more than its leading features in the body; but these include, after all, most of what it is important for us to be able to read, from a practical point of view.

The present essay will consider the probable origin of the structural points which constitute the permanent expression. These may be divided into three heads, viz.: (1) Those of the general form or figure; (2) Those of the surface or integument of the body with its appendages; and (3) Those of the forms of the head and face. The points to be considered under each of these heads are the following:—

I.—The General Form.

1. The size of the head.
2. The squareness or slope of the shoulders.
3. The length of the arms.
4. The constriction of the waist.
5. The width of the hips.
6. The length of the leg, principally of the thigh.
7. The sizes of the hands and feet,
8. The relative sizes of the muscles.

II.—The Surfaces.

9. The structure of the hair (whether curled or not).
10. The length and position of the hair.
11. The size and shape of the nails.
12. The smoothness of the skin.
13. The colour of the skin, hair, and irides.

III.—The Head and Face.

14. The relative size of the cerebral to the facial regions.
15. The prominence of the forehead.
16. The prominence of the superciliary (eyebrow) ridges.
17. The prominence of the alveolar borders (jaws).
18. The prominence and width of the chin.
19. The relation of length to width of skull.
20. The prominence of the malar (cheek) bones.
21. The form of the nose.
22. The relative size of the orbits and eyes.
23. The size of the mouth and lips.

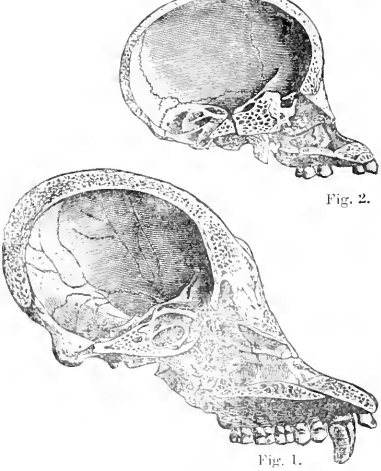


Fig. 2.

Fig. 1.

Fig. 1.—Section of skull of adult orang-outang (*Simia Satyrus*). Fig. 2.—Section of skull of young orang, showing relatively shorter jaws and more prominent cerebral region.

The significance of these, as of the more important structural characters of man and the lower animals, must be considered from two standpoints, the palæontological and the embryological. The immediate palæontological history

* Abstract of a lecture delivered before the Franklin Institute of Philadelphia, Jan. 20, 1881, in exposition of principles laid down in The Hypothesis of Evolution, New Haven, 1870, p. 31.

of man is unknown, but may be easily inferred from the characteristics displayed by his nearest relatives of the order Quadrumana. If we compare these animals with man, we find the following general differences. The numbers correspond to those of the list above given.

I. As to General Form.—(3) In the apes the arms are longer; (8) the extensor muscles of the leg are smaller.

II. As to Surface.—(9) The body is covered with hair which is not crisp or woolly; (10) the hair of the head is short; (13) the colour of the skin, &c., is dark.

III. As to Head and Face.—(14) The facial region of the skull is large as compared with the cerebral; (15) the forehead is not prominent, and is generally retreating; (16) the superciliary ridges are more prominent; (17) the edges of the jaws are more prominent; (18) the chin is less prominent; (20) the cheek bones are more prominent; (21) the nose is without bridge, and with short and flat cartilages; (22) the orbits and eyes are smaller (except in Nyctipithecus); (24) the mouth is small and the lips are thin.

It is evident that the possession of any one of the above characteristics by a man approximates him more to the monkeys, so far as it goes. He retains features which

Fig. 3.—Portrait of a girl at five years of age.

have been obliterated in other persons in the process of evolution.

In considering the physiognomy of man from an embryological standpoint, we must consider the peculiarities of the infant at birth. The numbers of the following list correspond with those already used.

I. As to the General Form.—(1) The head of the infant is relatively much larger than in the adult; (3) the arms are relatively longer; (4) there is no waist; (6) the leg, and especially the thigh, are much shorter.

II. As to the Surfaces.—(10) The body is covered with fine hair, and that of the head is short.

III. The Head and Face.—(14) The cerebral part of the skull greatly predominates over the facial; (16) the superciliary ridges are not developed; (17) the alveolar borders are not prominent; (20) the malar bones are not prominent; (21) the nose is without bridge and the cartilages are flat and generally short; (22) the eyes are larger.

It is evident that persons who present any of the characters cited in the above list are more infantile or embryonic in those respects than are others; and that those who lack them have left them behind in reaching maturity.

We have now two sets of characters in which men may differ from each other. In the one set the characters are those of monkeys, in the other they are those of infants. Let us see whether there be any identities in the two lists, *i.e.*, whether there be any of the monkey-like characters which are also infantile. We find the following to be such:

I. As to General Form.—(3) The arms are longer.

II. Surface.—(10) The hair of the head is short, and the hair on the body is more distributed.

III. As to Head and Face.—(21) The nose is without bridge and the cartilages are short and flat.

Three characters only out of twenty-three. On the other hand, the following characters of monkey-like significance are the opposites of those included in the embryonic list: (14) The facial region of the skull is large as compared with the cerebral; (15) the forehead is not prominent; (16) the superciliary ridges are more prominent; (17) the edges of the jaws are more prominent. Four characters, all of the head and face. It is thus evident that in attaining maturity man resembles more and more the apes in some important parts of his facial expression.

It must be noted here that the difference between the young and embryonic monkeys and the adults is quite the

Fig. 4.—Portrait of the same at seventeen years, showing the elongation of the facial region, and less protuberance of the cerebral.

same as those just mentioned as distinguishing the young from the adult of man (Figs. 1, 2). The change, however, in the case of the monkeys is greater than in the case of man. That is, in the monkeys the jaws and superciliary ridges become still more prominent than in man. As these characters result from a longer course of growth from the infant, it is evident that in these respects the apes are more fully developed than man. Man stops short in the development of the face, and is in so far more embryonic.* The prominent forehead and reduced jaws of man are characters of "retardation." The characters of the prominent nose, with its elevated bridge, is a result of "acceleration," since it is a superaddition to the quadrumanous type from both the standpoints both of palæontology and embryology.* The development of the bridge of the nose is no doubt directly connected with the development of the front of the cerebral part of the skull and ethnoid bone, which sooner or later carries the nasal bones with it.

(*To be continued.*)

* This fact has been well stated by C. S. Minot in the *Naturalist* for 1882, p. 511.

* See Cope, The Hypothesis of Evolution, New Haven, 1870 p. 31.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

(*Continued from page 106.*)

THE EVOLUTION OF CONDUCT.

Chapter II.

In considering the evolution of structures and functions we have not only to consider the influence of the struggle for individual existence, but also the effects of the contest in which each race as a whole is engaged,—and to do this we have to consider, first, those circumstances which affect the propagation of the race, secondly the relation of the individuals of the race to their fellows, thirdly the relations of the race as a whole to other races. Something akin to this must be done in considering the evolution of conduct. We have seen how modes of conduct which favour the continued existence of the individual are developed at the expense of modes of conduct having an opposite tendency. These last die out, because the individuals of the race who act in these ways die out. But it is obvious that conduct will be equally apt to die out which tends to prevent or limit the adequate renewal of the race from generation to generation. It is equally obvious that whatever conduct causes contests (whether for life or subsistence) within the race or species, tends to the elimination of members of the race, and so diminishes the chances of the race in the struggle for existence with other races. Lastly the relations of a race to surrounding races are manifestly of importance in the evolution of conduct, seeing that conduct will equally tend to be diminished whether it is unfavourable to the existence of the race in which it is prevalent, or simply unfavourable to the separate existence of an individual member of the race.

Now with regard to conduct affecting the propagation of a race, we find that, like conduct affecting individual life, it has been developed from what can hardly be called conduct at all in the lowest grades of life to fully developed conduct, with elaborate adaptation of means to ends, in the highest. In the lowest forms of life, propagation proceeds by mere division and subdivision, not depending so far as can be judged on any power of controlling the process, which such creatures may possess. In fact, the Protozoa multiply by dividing. We have to pass over many grades of life before we reach such imperfect care for propagation of the race as we find among those orders of fish in which the male keeps watch and ward over the eggs. Still higher must we pass before we find any trace of affection for the young, and higher yet before we see care given to feed and protect and keep the young till they are able to provide for themselves.

This brings us in fact very near to the human race, which, in its lowest races, is distinguished from other animals chiefly by the length of time during which it feeds, protects, and trains its young. In the higher human races all these processes are conducted with greater care and elaboration; more varied wants are considered and attended to, more elaborately varied means are used for the purpose. It is easily seen how such conduct by aiding the development of the race aids the development of the conduct itself by which that result is favoured. Among those members of a race in whom the proper race-propagating conduct is not adequately shown, propagation proceeds less effectively,—which is the same as saying that, relatively, such conduct itself must be diminishing.

This conclusion is not inconsistent, as at first sight it might appear, with the fact that mere numerical increase of propagation, though it means increase in quantity of life, is not always or even generally a proof of the growth of the race in what may be called race-vitality. Here as elsewhere adaptation of means to ends has to be considered, and that kind of conduct by which such adaptation is secured has the best chances of development in the long run. Let us, for instance, take an illustration from civilised life:—An early marriage between two persons careless alike of present duties and future difficulties, seems at first to tend directly to the increase of carelessness and thoughtlessness; for from such a union there will probably come into existence more than the average number of offspring, repeating in greater or less degree the weak characters of their parents: the totality of life characterised by undesirable qualities and conduct will thus be increased, and increased in a greater ratio than the totality of prudent, steady, and thoughtful life, by a well-considered union and well-judged conduct thereafter. Yet in the long run the result proves usually otherwise. (We consider only average results.) The larger number of offspring of inferior qualities, receive less care and inferior training: so that for them there is greater probability either of early death or of defective adult life. The parents suffer also in the struggle thus brought on them, for which they are ill-fitted. A diminished amount of life is likely to result, and (taking the average of many cases) probably does result; while certainly there is diminished life-quality. Hence results a correspondingly diminished amount and influence of the inferior kind of conduct shown by thoughtlessness or carelessness about life's duties. On the other hand, the well-judged and not too hasty union of two caretaking persons, though it may add a smaller number of individual lives to the life of the race, adds better and more enduring life, life more likely to maintain and sustain the qualities of the parents, giving therefore to these qualities in the race at once more stability and wider influence. In other words, the qualities best suited for the propagation of the race, and best suited for the race, will on the average be developed, while qualities having opposite tendencies will either be eliminated, or though they may remain will occupy a lower place and have diminished influence on the fortunes of the race—a circumstance tending of itself still further to their eventual elimination.

(*To be continued.*)

Pure nickel, after melting and casting, generally holds a greater or less quantity of oxygen in combination, and the metal is brittle. To hinder the injurious effects of the oxygen, it is necessary to incorporate in the melted nickel some substance which has a strong affinity for oxygen, and also for the nickel itself. According to the "Comptes Rendus," M. J. Garnier finds that phosphorus serves both of these purposes very satisfactorily, producing effects analogous to those of carbon in iron. If the phosphorus does not exceed three-tenths of one per cent., the nickel is soft and very malleable; above this quantity the hardness increases at the expense of the malleability. Phosphorised nickel, when alloyed with copper, zinc, or iron, gives results which are far superior to those that are obtained from the same nickel when not phosphorised. By means of the phosphorus Garnier has been able to alloy nickel and iron in all proportions, and always to obtain soft and malleable products. The contradictions of illustrious chemists are thus explained, some saying that such alloys were brittle, others that they were malleable. The latter had alloyed the nickel to phosphorised iron.—*Engineer.*

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By RICHARD A. PROCTOR.

(*Continued from page* 117.)

BUT now, returning to the mirror proof of the earth's rotundity, some readers of these papers, comparing together Fig. 8 and Fig. 9 may be led to ask why, in looking into a mirror as in Fig. 9, we do not recognise the water surface *c d* as curved like the surface A B. Ought it not they may say to curve downwards on either side of the vertical centre line across the sweetly pretty face in Fig. 9, just as it does on one side of the point A? A little consideration will show that this is precisely the same difficulty which is described in the Paradox Column at p. 77 by the anti-Copernican carpenter Mr. Hardy. He thinks or rather is certain that if the curvature of the earth can be recognised in the direction of the line of sight it ought also to be recognisable at right angles to that direction. If a ship twenty miles away is hull down, owing to the earth's rotundity, a range of twenty miles of sea horizon ought to show well-marked convexity. If our pretty observer at p. 101 can really see the sea-horizon depressed owing to the rotundity of the earth as illustrated in Fig. 8, he ought to see the horizon curve downwards to right and left of him.

It may be worth while to mention at the same time another difficulty. In Fig. 8, as in Fig. 3 p. 69, and Fig. 5 p. 85 we have an upright on the right which is not really upright, but parallel to the true upright at A; would not the argument be altered, and especially the part of the proof which is geometrically given, were the uprights C *c* in Fig. 3 and Fig. 5 and B *b* in Fig. 8, made really square to the surface on which they are supposed to stand?

Taking the latter difficulty first, let it be noted that C *c* in Fig. 3 may be set vertical without in the slightest degree affecting the argument. In the argument at p. 85, C *c* is described only as approximately parallel to A *a*; while B *b* in the argument at p. 101 is spoken of as "appreciably parallel." In reality the upright B *b* in Fig. 8, the case where the departure from parallelism is greatest, is so nearly parallel to A *a*, that though the eye might just be able to recognise the departure from parallelism, the real difference between A *b'* and *a b* would be far too small to be noticed on the scale of the figure. The curvature of the surface A *m* B is in reality monstrously exaggerated—though necessarily; and A *a* which is supposed to represent a height of only 200 ft. really represents a height of many miles. There had to be exaggeration somewhere, or *b b'* and *b'* B would have been invisible; putting B *b* at right angles to the surface at B would not have made matters much worse, but it would have suggested the additional error that *b* is much farther from *a* than *b'* is from A. The argument would have been in no way affected.

Let us, however, inquire what the true proportions of the lines in Fig. 8 should have been, or the true lengths if any given length is assigned. Suppose *a b* to represent 17 miles, being in actual length 3·8 inches. Then since B *b* should represent 400 feet, and 400 feet are contained about 225 times in 17 miles, the length of B *b* in the figure should be the 225th part of 3·8 inches, or considerably less than the fiftieth of an inch. If the student will draw a line as A *b'*, 3·8 inches long, take A *a*, *b' b*, and *b'* B, each less than the hundredth of an inch, and fill in a curved surface A B touching A *b'* at A and *a* B at B, he will get a good idea at once of the slightness of the real curvature of A B and of the utter insignificance of any difference between the uprightness of the tiny line B *b* and the parallelism of that line to A *a*.

Or we may take B *b* the same in length as in Fig. 8 to represent 400 feet, and inquire what should be the length of *a b* to represent 17 miles. The actual length of B *b* is about seven-tenths of an inch. Multiply this by 225 and we get 157½ inches or more than 13 feet. Imagine B *b* and A *a* unaltered in length but set close on 4⅓ *yards* apart, A *b'* and *a* B drawn, and A *m* B carried with a circular sweep to touch these lines at A and B respectively. It would require a radius of about 1,000 yards or considerably more than half-a-mile This is the kind of curvature which some think we ought to recognise in looking (as in Fig. 9) into a mirror half a-foot, perhaps, square. As for the displacement of *b*, owing to B *b* being parallel to A *a* instead of perpendicular to the surface at *b*, this displacement even on the enormous scale just considered (in which B *b* represents 400 feet, and the radius of A *m* B is more than half-a-mile long) corresponds only to setting *b* to the left of its true place by less than the 200th part of the length B *b*, or by about 1-320th part of an inch.

Take we now the other difficulty, though it has indeed been already disposed of by the reasoning just run through.

Why should not the sea-horizon, whether viewed directly or by reflection in a mirror, seem curved?

Suppose an observer whose eye is 200 ft. above the sea-level looks at the long horizontal roof-ridge of a house, beyond which lies a sea horizon, and that he brings the middle of the ridge just below the sea-horizon exactly in front of him—ought he not as his eye ranges to right and left along the ridge, to lose the sea-horizon through its curving down below the ridge? Or, if he brought the ends of the ridge exactly level with the sea-horizon, ought not the sea-line to stand visibly above the middle of the ridge?

Theoretically it ought and it does; practically the question is one of degree, and our inquiry must be, how *much* does it curve?

Suppose the ridge to be 50 ft. long, and its middle point 25 feet from the eye, so that in sweeping along the ridge the eye ranges over a right angle. Suppose also a fixed point set near the eye to guide it, for otherwise the observation would be altogether inexact. Every line of sight must be taken athwart this fixed point, 25 feet from the centre of the perfectly horizontal ridge line, to different parts of this line; and what we want to find is how much the lines of sight to either end of the ridge line pass above a line of sight to the sea-horizon there, when a line of sight to the middle of the ridge line just touches the sea-horizon.

Let *a*, Fig. 13, be the fixed point athwart which the lines of sight are taken, E B F the roof ridge, 50 feet long, B its middle point; *a* B square to E F; and *a* B=E B=B F =25 ft. Let *a* vertical plane through E B F cut the true horizontal plane through *a* in *e b f*, and let E' B' F' represent the sea horizon as supposed to be seen on this plane; *e* E E', *b* B, and *f* F F' being vertical lines. We want to find the length of E E' and F F'.

Now obviously B *a b* in Fig. 13 represents the same angle as B *a b* in Fig 8 as dealt with at p. 101. For, produced far enough—really to some 17⅓ miles—*a* B would meet the sea surface and be the *a* B of Fig. 8; *a b* of Fig. 13 would then be the *a b* of Fig. 8; and *b* B would therefore be 400 ft. The proportions of the triangle B *a b* would be precisely the same in both cases (because we are dealing with a point *a* in each case 200 ft. above the sea-level). In each case B *b* (as shown at p. 101) is 1-228th part of *a b*. But *a b* in Fig. 13 represents 25 ft. Therefore B *b* represents 25 ft. ÷ 228, or about 1⅓ in.

But it is clear that the triangles $e\,a\,E'$ and $f\,a\,F'$ are also similarly proportioned to $B\,a\,b$ of Fig. 8. For $a\,e$, like $a\,b$, is truly horizontal, and $a\,E'$ like $a\,B$ is directed to the sea-horizon. It matters not in what direction we look

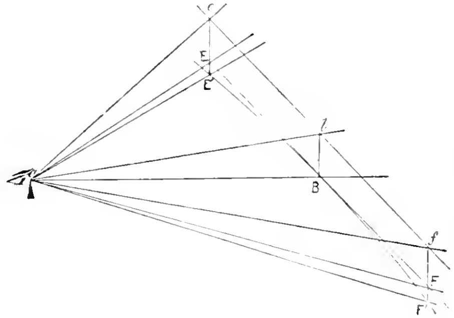


Fig. 13.

seawards from a fixed point above the sea; the sea-horizon has always from such a point the same depression. The only difference is that $a\,e$ and $a\,f$ are longer than $a\,b$, while $e\,E'$ and $f\,F'$ are longer than $b\,B$ in the same proportion.

Whereas then $B\,b$ is about $1\frac{1}{3}$ in. in length, $e\,E'$ and $f\,F'$ exceed $1\frac{1}{3}$ in. in the same degree that $a\,e$ or $a\,f$ exceeds $a\,b$; which is (appreciably) the same degree in which $a\,E$ or $a\,F$ exceeds $a\,B$, that is as the diagonal exceeds the side of a square (for $a\,B$ and $B\,E$ are equal and at right angles to each other). Thus since the diagonal of a square is about 1·414 when the side is 1, we have

$$e\,E' = f\,F' = 1\tfrac{1}{3}\text{ in.} \times 1{\cdot}414$$
$$\text{and } e\,E = f\,F = 1\tfrac{1}{3}\text{ in. (each being equal to } B\,b);$$
$$\therefore\ E\,E' = F\,F' = 1\tfrac{1}{3}\text{ in.} \times 0{\cdot}414 = {\cdot}55\text{ in. approximately}$$

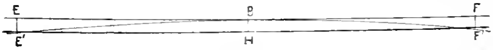


Fig. 14.

In reality, taking refraction into account the angles of depression are all reduced by about one-fifth, leaving $E\,E'$ and $F\,F'$ optically equal to only ·44 in., or $\frac{4}{9}$ths of an inch. The actual curvature of $E'\,B\,F'$ would be fairly shown if in such a diagram as Fig. 14, E B and B F were each 25 ft. long, $E\,E'$, B H, and $F\,F'$ each $\frac{4}{9}$ths of an inch long; and if then the curve E B F were swept out in the narrow rectangle $E\,F'$, whose length *would be more than thirteen hundred times its breadth.*

So that even from so great a height as 20 ft., a ridge roof so long as 50 ft., seen from a distance of 25 ft., commanding therefore a range of a full right angle along the roof, and brought at the two extremities to exact apparent coincidence with the sea-horizon would be less than half an inch below the sea-horizon at its middle point, even if use were made of such a point as a (Fig. 13) to guide the eye.

But all the observations ever made in this way, as by Parallax in 1864, by Mr. Hardy (see page 77), and by a few perplexed students of this matter, have been made from lower levels than 200 ft., on ridges commanding a much smaller angle than a right angle, and without any such a point as a to guide the eye, though such a point is absolutely essential to exactness of observation. As for the mirror experiment of page 101, that, with a one-foot mirror and two yards distance would command an arc of less than five degrees of sea-horizon, and it would be preposterous to expect the slightest trace of curvature along such an arc.

(*To be continued.*)

PUNCTUATION AND PRINTERS.

I WONDER what the *Brighton Herald* takes to be "the rights and privileges of the humble comma." Apparently the right of distraction; for everything that unduly stops the continuity of thought in reading is distraction—parentheses, whether written so or not, unnecessary or too strong stops, all sorts of carts before horses, exceptions and conditions stated at the beginning instead of the end of a sentence, verbs before their nominative cases or after their accusatives, except for special reasons, anything that obliges you to wait till the end in order to realise what the sentence is about. These things, and not the mere length of sentences are the impediments to easy reading.

I forget whether you noticed before the printers' passion for *dibbling* in a comma between every two adjectives not already separated or joined by an *and*, without the least regard to its effect. For instance somebody might write that I am a "good tall man," meaning only that I am above the average height: the average printer would forthwith exalt me into a "good, tall man"; and thereby would raise the indignation of every architect in England into a still hotter flame than it is in just now I see, at my having dared to rebuild part of a cathedral without paying them some £1,500 of black-mail for doing worse than nothing, or something like the Law Courts.

But I want to go beyond commas, and to give even the Devil his due. Some men deliberately leave their punctuation to that inky Diabolus, and it is well for their readers and their own credit that they do. Within the last month or so I have had letters from two men of excellent education, both High Wranglers and men of science—one old and the other young—whose only stops were commas and dashes, dashed in pretty much *ad libitum.* Such writing would justify quite natural language from a printer's devil; and if he is to be condemned himself for doing his best—and rather overdoing it—he may fairly call the world ungrateful. But, on the other hand, he must see in five minutes whether he is printing for a punctual punctuator like you or me, who, at any rate, mean to put in all our stops; and when he sees that he ought to leave us alone to bear our own iniquities if we let our proofs go "unpeppered" more than he thinks right. We probably know better than he does.

The fact is that any one who attempts either to punctuate or to write English entirely by rules is sure to disregard both sense and common sense sometimes. But one rule may be safely followed, viz., the advice of some judicious bishop to his clergy on the length of sermons, to "err on the side of leniency;" and the other still older rule—*Quid dubitas ne feceris*, if you doubt about a comma leave it out.

The Greeks were wiser than we are in not encumbering themselves with both colon and semicolon. Nobody can say with certainty ὅσῳ πλέον ἥμισυ πάντος, how much less a semicolon is than "the entire animal," from which it differs only by a tail. What is really wanted is a kind of minor comma, or both that and the semicolon reducing a little in power of obstruction. But that reform is as hopeless as an Easter by the sun instead of the (Act of

Parliament) moon, though everybody would welcome it if it came somehow with no questions asked.

If anybody doubts your opinion of Macaulay's style, which was always mine, let them try it by the test of reading it aloud, against Froude's, or Hume's old but matchless History, and they will soon find how tiresome it is. I have made his admirers give in by that test. Gibbons is sickening when you have learnt the trick of it, and its want of simplicity. I never saw Mr. Spencer's "Essay on Style" (is it a separate book ?*). Some of his own is good enough; but when he wants to be particularly precise and lucid he is often particularly the contrary, and his style, in my opinion, most abominable. Nevertheless, he may preach better than he practises, and inculcate better English than philosophy, in spite of Mr. T. Foster.

Edm. Beckett.

THE FACE OF THE SKY.

From Aug. 31 to Sept. 14.

By F.R.A.S.

The usual daily watch will be kept upon the sun for spots and faculæ. The aspect of the night sky is shown in Map IX. of "The Stars in their Seasons." Mercury attains his greatest eastern elongation (26° 42′) from the sun on the 11th, but sets too nearly with the sun now to be visible to the naked eye. Venus is quite invisible. Mars rises before 11 h. 30 m. p.m. now; but, as we said a fortnight ago, merely presents the appearance of a very large red star in Gemini. Jupiter does not yet rise until after midnight. Saturn rises before 10 p.m. on the 1st of September, and soon after 9 o'clock by the 14th, so that he will be well above the horizon by midnight. He is situated between 3° and 4° north of Aldebaran, and just to the East of it. Uranus and Neptune are both invisible. The moon's age at noon on Aug. 31 is 28·1 days; and at the same time to-morrow it will evidently be 29·4 days. Her age on Sept. 2, at noon, is 0·9 day, and quite obviously will be 12·9 days by the 14th. Two occultations of stars will take place on the night of the 14th—firstly of c^1 Capricorni, a 4½ magnitude star, which will disappear at the moon's dark limb at 8 h. 41 m. at an angle of 171° from her vertex, reappearing at her bright limb, at an angle of 208° from her vertex, at 9 h. 5m. p.m. At 8 h. 47 m. p.m. c^2 Capricorni, a star of the 6th magnitude, will disappear at the dark limb of the moon, at a vertical angle of 91°, to reappear at her bright limb, at 10 h. p.m. at an angle of 300° from her vertex. The moon, after travelling through a portion of Leo, descends into Sextans about 10 p.m. on Aug. 31, and (occupying about 9 hours in crossing the northern part of that constellation) re-enters Leo at between 7 and 8 p.m. on Sept. 1. It is between 9 and 10 o'clock on the night of Sept. 2 before she finally quits Leo and enters Virgo. It takes her until 9 a.m. on the 6th to cross this constellation; from which, at the hour named, she passes into Libra. Her passage through Libra occupies, as nearly as may be, 48 hours, and about 9 a.m. on the 8th she enters the northern part of Scorpio; over this she takes 12 hours to travel, and at 9 p.m. crosses into the southern part of Ophiuchus. Skirting, for a very short time, the extreme southern limit of Serpens, she travels into Sagittarius about 5 o'clock in the afternoon of the 10th. She does not leave this constellation for Capricornus until 2 a.m. on the 13th. It takes her until between 5 and 6 p.m. (or some 15½ hours) to go over the northern part of Capricornus, which she then quits for Aquarius. She is still crossing Aquarius on the 11th.

It is stated that there are 3,985 paper-mills in the world, producing yearly 959,000 tons of paper made from all kinds of substances, including rags, straw, and alfa. About one-half the quantity is printed upon; and of those 476,000 tons, about 300,000 tons are used by newspapers. The various Governments consume in official business about 100,000 tons; schools, 90,000 tons; commerce, 120,000 tons; industry, 90,000 tons; and private correspondence another 90,000 tons. The paper trade employs 192,000 hands, including women and children.

* It is in the second volume of his collected essays.—R. P.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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PHENOMENA OBSERVED IN RAILWAY TRAVELLING.

[906]—When travelling in a train and looking out of a window, the nearest objects appear to me, of course, to fly rapidly backwards, and the more distant to go slower until those on the horizon seem to travel slowly in the same direction as the train. If I have been looking out of the window at the landscape for some time, and the train stops, the landscape appears to slowly unwind itself, as it were, the nearer objects moving slowly forwards, and the remoter just perceptibly backwards. I should like to know whether this is a common experience, or one peculiar to my own somewhat over-sensitive nerves. I should also like to know whether the phenomenon is analogous to that of complementary colours. I explain it to myself by supposing that while the train is in motion the nerves of the lower part of the retina are continually conveying impressions of forward motion (the nearer objects being, of course, reflected upon the lower part of the retina), and those of the upper part conveying impressions of backward motion. Then, when the nerves are no longer excited from the outside they rest themselves by complementary sensations, as in the case of complementary colours.

Hoping that I have not wasted your valuable time in describing what you are already familiar with, Leonard Brown.

LUMINOUS RING.

[907]—I enclose two photographic prints—one of my chemical laboratory, the other of my dining-room—both taken by gaslight. In each of these (and, of course, in the negatives) I observe a perfectly well-defined circle of light surrounding the gas-flame.

I showed the pictures to my friend Mr. Grensted, who gave what seems to me a very satisfactory explanation of the matter, and one, indeed, which is interesting as affording another instance of the analogy which exists between the human eye and the photographic camera. Chas. Harris.

With regard to the above, I have for many years seen a prismatically-coloured similar ring, with the naked eye, when looking at a candle-flame against a background of shadow. I thought it to be either an emanation from the flame or caused by floating particles in the eye. The first hypothesis is disproved by the fact that one of the prints shows the ring overlapping the frame in which it is reflected. The constitution of a camera lens disproves the second. Is it a diffraction ring caused by reflections from the interior surfaces of the lens? Fred. F. Grensted.

FLIGHT OF A VERTICAL MISSILE.

[908]—*Conservation of Angular Momentum.* By this principle practical engineers perform such operations as adjusting a balance-weight to the driving-wheel of a locomotive. Stated in this form it carries its own proof with it, being simply another expression for the law that action and reaction are equal and opposite. Had the principle been generally known by this phrase, it would have guided your correspondent, Mr. Bray, to a correct solution of the problem. The ball, instead of moving east with the velocity of a point on the earth's surface, moves east with a velocity inversely as its distance from the earth's centre. Measuring the arc so described at the mean height evidently doubles his former result.

The term "Kepler's second law" conveys no particular meaning —in fact, Clifford, in his "Dynamic," 1878, calls it Kepler's first law, and it is sometimes misunderstood to apply only to forces varying inversely as the square of the distance. "Angular momentum" seems a preferable term to "moment of momentum." "Conservation of areas" is a very misleading designation.

The writer suggests that in the same way as the term *half the vis viva* has been superseded by *energy*, so now might *Kepler's second law* be replaced with advantage by the expression *Conservation of angular momentum*. A. Barclay.

WART-CHARMING (SO-CALLED).

[909]. I am both amazed and amused at the wonderful theories started upon the very simple subject of destroying warts. Will you allow me to give a simple explanation of a natural process, which has as little connection with the "imagination" or the "influence of mind on body" as the moon has with green cheese?

Pasteur has killed small animals by inoculating them with the saliva of an ordinary living person. To this poisonous quality of the saliva (especially so in the mornings and evenings) most of the feats of so-called wart-charming may no doubt be traced.

I myself had a wart on my left cheek for a very considerable time, caused, no doubt, by an unclean razor. I wetted the wart with my own saliva every morning and evening, and in about a fortnight the wart had entirely disappeared.

It is evident that persons less fond of soap and water, or those with disordered stomachs, possessing, therefore, a more poisonous saliva, may effect quicker cures.

I have always found it more reliable and satisfactory to seek for the natural cause of everything than to ascribe it to the supernatural and marvellous. Mephisto.

[Our friend from warmer regions ought to know what is supernatural and what not: but he appears not to do so. The influence of mind on body is among observed natural phenomena, and cases of so-called wart-charming are among the most interesting illustrations, but certainly not by any means the most surprising. The saliva is not used in one case out of twenty.—R. P.]

SOME AMERICAN WARTS.

[910]—When a boy in Concord, Massachusetts, only thirteen years ago, I had about a dozen warts on my hands. Another boy told me that Mr. C——, the jeweller, could charm them away. I had two years before removed a lot of warts under direction of my mother by applying three times a day a saturated solution of sodic carbonate, and had much less faith in charms than in chemicals. My playmate, however, maintained that his warts had been removed by the charming process, and so I went to the jeweller and asked the same favour. He rubbed his fingers over each one, and told me to put on them every day the juice of the milkweed (*Asclepias cornuta*). I did this as often as I thought of it, and the warts gradually became smaller, and after a few weeks I was surprised to notice that they were gone. The success did not convince me of the efficacy of charming, for "they say" in Massachusetts that milkweed juice will cure warts, and I have thought that the metals which the jeweller handled may have given some virtue to his touch. Fritz F.

New York, *Aug.* 7.

GINGER-BEER PLANT.

[911]—The ginger-beer plant described by T. H. Perry (878) is probably an aggregation of one of the yeast-plants. The aëration of the water is no doubt effected by the vegetative process induced by the sugar. Substitute essence of lemon for the ginger, and you will have a "lemonade" plant.

W. H. Shrubsole.

IRON SHIPS AND FLOATING DOCKS.

[912]—Will you kindly allow me to inquire through your columns whether the builders of iron ships ever make allowance for the effects of wide differences of temperature in producing irregular expansion and contraction of the metal, and consequent cracks and fissures? Fownes says in his "Manual of Chemistry" that "the force exerted in the act of expansion (by heat) is very great. In laying down railways, building iron bridges, erecting long ranges of steam-pipes, and in executing all works of the kind in which metal is largely used, it is indispensable to make provision for these changes of dimensions." Yet I am told that this rule does not apply to iron ships, as in them the expansion or contraction is uniform. May I venture to ask if the immersion in water has no neutralising effect, and whether also the building of iron ships has been tried to any extent in countries subject to great variations of temperature, such as Norway and Northern Russia? To put the question as plainly as I can in my utter ignorance of the appropriate technical language, would a builder be willing to leave the shell of an iron ship the whole year through without any covering in such a country as those just named, and expect no harm to result from the vicissitudes of the weather, leaving out of view the liability to rust?

I am induced thus to trouble you on account of a question which has lately arisen as to the immunity of iron floating docks from the risk of having their efficiency impaired by exposure to the wide variations of temperature that occur in certain climates. It has been stated positively by a presumed authority that "the expansion and contraction of the iron in a dock would have the same effect as in a ship," and yet it seems to me that the resemblance between the two structures is not so exact as to make that proposition self-evident.

Again, it has been publicly stated that "as the advanced science of the present day demands the use of iron and steel for the construction of ships, so it does for docks, and in the whole of Europe at the present time no engineer would think of using any other material in their construction." Is this true or is it not?

X + Y.

HEIGHT OF ANCIENT EGYPTIANS.

[913]—Being much interested in Egyptology in all its phases, I recently made a tour up the Nile, and having previously noted some statements respecting the sizes of certain mummies, when in Cairo I measured several, especially those of the recent great find in Thebes. I give my measurements below, and would be glad if it leads to an "official" publication, as it would settle a good many points in reference to this interesting and remarkable ancient race.

Measurements.

King Unas VI. Dynasty	4 ft. 9 in.
King Ra Skemen XVII. Dynasty	5 ,, 8 ,,
King Amenoph 1st XVIII. Dynasty	5 ,, 2 ,,
King Amosis XVIII. Dynasty	5 ,, 0 ,,
King Thothmes 2nd XVIII. Dynasty	5 ,, 6 ,,
King Sethi 1st XIX. Dynasty	5 ,, 2 ,,
King Rameses 2nd XIX. Dynasty	5 ,, 1 ,,
King Pinotem 1st XXI. Dynasty	5 ,, 0 ,,
Queen Nofritasi XVIII. Dynasty	5 ,, 4 ,,
Queen Notimaut XIX. Dynasty	4 ,, 8 ,,
Queen Makara XXI. Dynasty	4 ,, 6 ,,
Baby of ditto	1 ,, 0 ,,
Princess Trinkheb XXI. Dynasty	4 ,, 9 ,,
High Priest Nebsemui XXI. Dynasty	5 ,, 6 ,,

The coffin of Rameses measures only 6 ft. 3 in. over all, and the mummy does not reach to the wood (the thickness of which is 2 in.) by several inches. Wm. Oxley.

SINGULAR NUMERICAL PROPERTY.

[914]—I send the following as curious example of figure-magic, with the hope that it may be of interest to readers of Knowledge:—

If the number 142,857 be multiplied by 1, 2, 3, 4, 5, or 6, each result gives the same figures in the same order, only beginning at a different point. Thus:—

$$142{,}857 \times 1 = 142{,}857$$
$$142{,}857 \times 2 = 285{,}714$$
$$142{,}857 \times 3 = 428{,}571$$
$$142{,}857 \times 4 = 571{,}428$$
$$142{,}857 \times 5 = 714{,}285$$
$$142{,}857 \times 6 = 857{,}142$$

If it be multiplied by 7, we get all nines. Thus:—

$$142{,}857 \times 7 = 999{,}999$$

If it be multiplied by 8, we get 1,142,856. Now add the first figure to the last, and we have the original number—142,857. If it be multiplied by 9, we get 1,285,713, and then we find that the sum of the digits of the product is equal to the sum of the digits of the original number, each being 27.

Moreover, the sum of the digits of each product is the same in every case but one, namely, when we multiply by 7, and then the sum of the digits is 54, or just double the sum of the digits in each of the other products. H. Askew.

[The number 142,857 is $999{,}999 \div 7$, and is also what we get on dividing 1,000,000 by 7, less $\frac{1}{7}$. Now noting that 10, 20, 30, 40, 50, or 60, when divided by 7 leave remainders 3, 6, 2, 5, 1, and 4, &c., all the digits less than 7, that 80 divided by 7 gives 11, with remainder 3, and that 90 divided by 7 gives 12 and remainder 6, we find all the above facts accounted for, seeing that the digits in dividing 1000000, 2000000, 3000000, &c., to 6000000 must recur in

the same order, though beginning with a different digit of the set; in the case of 8000000 and 9000000 we have $999{,}999 \times 8 + 1\frac{1}{7}$, and $999{,}999 \times 9 + 1\frac{2}{7}$.—R. P.]

LETTERS RECEIVED, AND SHORT ANSWERS.

W. BAYLEY.—Thanks for cuttings; but of course the toads were never vomited.—J. CLAYTON. Handbook of stars out of print.—JAS. PAXMAN. Illness following railway accident drove the matter from my thoughts.—J. HARRISON, SEN. Many thanks for the weather charts.—A READER. You will have seen ere this that I quite agree with your objections to cholera-prescribing here, as in *Health*, and other such organs.—IGNORAMUS. Stephenson said to a perpetual motionist, "Carry yourself round the room by your own waist-band, and I will consider your plan." That is about what it comes to.—W. W. W. Regret, but no space.—JAS. LUCKING. Do not know where model of first pair of spectacles can be seen. Am also unable to say where a photograph of Adam and Eve is preserved.—A. H. SWINTON.—Your determination of sun-spot maxima from years of great natural phenomena seems to me as funny as determining comets—otherwise unknown—from deaths of kings and rulers. Prove the connection between volcanoes and sun-spots and we will see about it.—H. H. Thanks for kind wishes.—D. N. Certainly not new. A hundred such relations could be written down in a few hours.—E. C. CASTLEBAR. Earth's shape seems to trouble you. When and where have I said I admired the person you mention? But reading the sickly works of the other writer would have had no influence one way or the other.—E. H. STUTTER. Many thanks for your kind letter.—SENEX. Not unusual. Showing want of symmetry, not that penumbra was not lower than photosphere.—H. W. JONES. No space or time for explanations of so much text-book matter.

Our Mathematical Column.

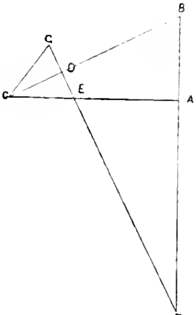
GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART XIV.

A READER of these mathematical notes sends for solution, by use only of Euclid's first three books, the following problem:—

PROB.—A B C *is a right-angled triangle. From any point* D *in the hypothenuse* B C *a straight line is drawn at right angles to* B C, *meeting* C A *at* E *and* B A *produced at* F: *show that the square in* D E *is equal to the difference of the rectangles* B D, D C *and* A E, E C; *and that the square on* D F *is equal to the sum of the rectangles* B D, D C *and* A F, F B.



We notice at once, that the rectangle A E, E C mentioned in first part of the problem is equal to the rectangle D E, E F, since the angles at D and A are right angles so that a circle will pass through the points C, D, A, F. Also we notice at once that the rectangle A F, F B mentioned in the second part of the problem is equal to the rectangle E F, F D, since a circle will pass through the points A, B, D, E. This leads us at once to think that we may find the solution of our problem, by using those theorems of the second book of Euclid in which a square on D E, a part of a line, is shown to be the difference of two rectangles, and a square on D F, the whole of a divided line is shown to be the sum of two rectangles. But in each case we must bring in the rectangle related to the line D E F which we have seen to be equal to a rectangle referred to in the puzzle.

Thus, first, we ask how the rectangle D E, E F is related to the square on D E. We know that

$$DE^2 = \text{rect. } DE \,.\, DF - \text{rect. } DE \,.\, EF.$$

If then we can show that the rect. D E. D F is equal to the rectangle C D, D B, what is required, so far as first part of our problem is concerned, is done. Now as we are dealing with the third book, this naturally leads to the idea that if a circle is carried around the points C B F, we may be able to show that F D which intersects C B in D, will when produced cut this circle in G, such that D G = D E. For we want to show that the rect. C D, D B = rect. D F, D E; and we know that the rect. C D, D B = rect. F D, D G. But this leads us directly to the solution of this part of the problem. For if we suppose the circle through C, B, F, to cut F D produced in G, we have $\angle CGF = \angle CBF$ in same segment $= \angle CED$ (since each is the complement of $\angle BCA$): hence the triangles C G D and C E D are equal in all respects, and D E = D G.

The other part of the problem is found to depend on the same construction: for

$$\begin{aligned} DF^2 = DF \,.\, EF + DF \,.\, DE &= BF \,.\, AF + DF \,.\, DG \\ &= BF \,.\, AF + CD \,.\, DB \end{aligned}$$

We may put our solution into the following form:—

Produce F D to G making D G = D E and join G C. Then since the angles at D are right angles

$$\angle CGD = \angle DEC = \text{compt. of } \angle DCE = \angle CBA.$$

Hence a circle will pass through the points C, G, B, F; also obviously a circle will pass through the points C, D, A, F; and another circle through the points D, E, A, B. Hence

$$\begin{aligned} \text{rect. } CD, DB &= \text{rect. } GD, DF = \text{rect. } DF, DE \\ \text{rect. } CE, EA &= \qquad\qquad\qquad\quad \text{rect. } EF, DE \\ \text{and rect. } AF, FB &= \qquad\qquad\qquad\quad \text{rect. } DF, FE \end{aligned}$$

$\therefore$ rect. CD, DB − rect. CE, EA = rect. DF, DE − rect. EF, DE = DE^2
and rect. CD, DB + rect. AF, FB = rect. DF, DE + rect. DF, FE = DF^2

Q. E. D.

Our Whist Column.

By "FIVE OF CLUBS."

TAKING PARTNER'S TRICK.

MY partner leads a Queen original lead, I hold Ace, King, and Two. Not a possible trick in any other suit, save Trumps. Love all. To his lead, I play the King, lead the Two of Trumps, having Two, Three, Knave, and Queen. My partner wins with the King, leads Ace, follows with the Four, leaving me with the thirteenth trump and the lead; I play Ace of his suit, then the small one. Have I made the most of my hand? Did I lose anything by taking his Queen with my King? Are there any circumstances under which I can lose by playing King on my partner's Queen, holding Ace, King, and one small one? Supposing my partner knows the conventionalities of modern Whist, I expect him to play from his long suit. No card in my hand or played by second player tells me whether his lead is from weakness or strength; therefore I put on my King in order to get out of his way. If his lead is from two I assume he has not four trumps, and wishes to make a trump on that suit. If his lead is from Queen, Knave, and a small one, or Queen, Knave, and anything, I contend I lose nothing by playing my King. If he hold Queen and one other and I let it go, he plays the small one I put on my King. If I then play my Ace his discard is no use to him, or me either, and instead of playing to win the game I am forced to feel my way to the end. He has exposed his hand to the entire party, and leaves me to get out of the mess the best way I can. If he holds a long suit, of which he leads the Queen, I contend that to play the small card would be wrong. The play succeeded. His suit proved to be a long one, Queen, Knave, ten, and others. He afterwards told me I knew nothing about the game, and never to do so again, although it "came off." "He had played Whist forty years." I being a young player, gave up the argument, believing I was right. He also advised me never to take my partner's trick; but having brought off *Deschapelles' coup* five times last winter, I voted my old friend a "duffer."

Hoping I have not exhausted your patience, and that I may be informed in your next, I am, dear Sir, yours, &c. MUFF.

[If you had played your small card, the evil consequences which would almost inevitably have followed would have emphatically justified the name you assume without having made out any case for its use. Your partner only *thinks* he has played *Whist* forty years.—FIVE OF CLUBS.]

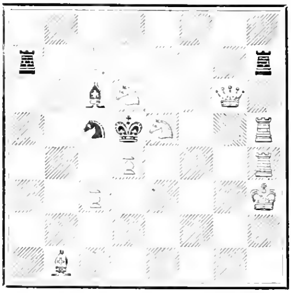
Our Chess Column.

By Mephisto.

PROBLEM No. 94.

By E. N. Frankenstein.

Black.



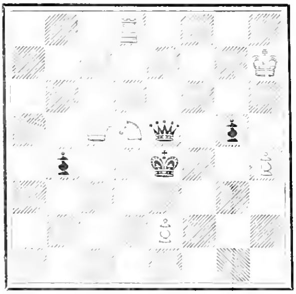
White.

White to play and self-mate in five moves.

PROBLEM No. 95.

By J. C. S.

Black.



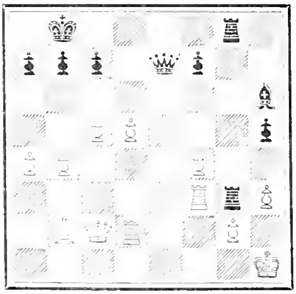
White.

White to play and mate in three moves.

ENDING FROM ACTUAL PLAY.

E. N. Frankenstein.

Black.



White.

Dr. P.

Black to play and win in the least number of moves.

SOLUTIONS.

Problem No. 91, by W. Terrill, p. 96.

We are glad to say that this problem is quite correct as published, which may be seen on working out the solution. The position is as follows:—White—K on K sq., R QR sq., P QKt2, R KR3, P KB4, Kt Q5, Kt QR5, Q QB6, B K6. Black—B or KR sq., Q KB sq., R KR4, P Q5, B QKt6, K Q6, P K6.

1. Kt to B3	R to Q4	P takes Kt
2. Q to B4 (ch)	B takes Q	B takes B / Q to Kt4
3. Castles mate.		R to Q sq., mate.

(if 2. K to B7, 3. Q to Kt2, mate.

Problem No. 92, by J. C. S., p. 112.

1. B to B2	1. P to K6
2. R to B4	2. P takes B
3. P to K4, mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W.—Castling is not prohibited in problems, although interdicted in some tournaments. Castling being a legitimate move at Chess, we fail to comprehend why it should not be resorted to. Clearly, if there is no other way of effecting a mate than by Castling, it is evidently then the author's idea, as suggested by the non possibility of effecting a mate in any other way. We do not see any trickery about it. If a composer was to construct a problem which admitted of a mate being given by Castling as well as by another move, and in reply to the solution by Castling were to declare that move impossible on account of the K having previously moved, that would amount to deception, and would be inadmissable. In no other way can Castling possibly lead to a misunderstanding. However, as long as the majority of problemists are opposed to Castling, it ought not to be resorted to for that reason.

W. Terrill.—Pray excuse our error; we have been led into it by a correspondent.

J. Berger Gratz.—Letter and contents received with many thanks.

Berrow.—If 1. P takes Kt, then 2. B takes B. See solution published above.

C. Planck.—Problem received with thanks.

William W. Thomson.—If 1. B takes Q, P takes B. 2. Q to R sq. (ch), the Kt can interpose on R4. See solution published above.

R. B. Sargeant.—We shall make inquiries and inform you accordingly.

Problem No. 91 correctly solved by Schmucke, H. A. L. S., and John; and Problem No. 93 by Stanley B. Baxter, M. T. Hooton, John Watson, John, Schmucke, Berrow, W. R. Edwards, and H. A. L. S.

Contents of No. 95.

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AN ILLUSTRATED MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

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Contents of No. 97.

HOW TO GET STRONG.

IN MIDDLE AND ADVANCED LIFE.

In the last few papers we have considered, with a purpose, how fat may most effectively and at the same time most advantageously be reduced. Our reason has been that several correspondents, not claiming to be entitled to become members of the Fat Men's Club, but still too fat for comfort, have asked whether there is any way in which they can participate without discomfort in exercises which they supposed meant only for those in good condition. It will be seen on a careful reading of our remarks upon their requirements that nearly everything recommended for them is good also for those who are not in the least troubled with obesity, nay even for those who are positively lean. Our suggestions for reducing weight are nearly all in reality suggestions for increasing flesh. A great deal of fat may in the case of the corpulent be removed while little flesh is put on, and so the weight may be greatly reduced; but it is almost impossible to follow any sound regimen for reducing fat without adding flesh. Indeed testing methods for reducing fat by merely weighing is not satisfactory. Taking two corpulent men of equal weight and equally fat, one shall by potions, unwholesome food, undue sweating (without exercise) and in kindred ways, take twenty five pounds off his weight in a month; while the other will in the same time by healthy exercise, cold bathing, and attention to the points touched on in preceding papers, lose no more perhaps than some five or six pounds; yet the former shall feel weaker and more oppressed by his weight than before, while the other will be altogether heartier and more vigorous, lighter and more active, than he had been. In one case perhaps some twenty pounds of fat and some five pounds of flesh have been lost: in the other, some ten pounds of fat only may have been lost while five pounds or so of flesh have been added. It is not difficult to see which of the two has gained most by his fat-reducing efforts; or rather one has gained all round, while the other though twenty or twenty-five pounds lighter is a much weaker man than before he lost the weight.

When we consider the effect of one and the other process on inferior organs such as the heart and lungs, &c., we see still more clearly the superiority of a system by which while fat is reduced flesh is increased. The fat man's heart for instance is not only overloaded with fat, but the heart-muscle is weaker than it should be: to reduce or even remove the fat by a process which at the same time weakens the muscle, is to do at least as much harm as good,—probably more. But a regimen which gradually removes the fat, while increasing not only the quantity but the quality of the muscle, is good all round. In the long run such regimen leads to the more complete and permanent reduction of fat also. For the man who has simply wasted is not in a fit state to resist the return of fat which begins so soon as the wasting process has ceased. He is far more likely to be simply prostrate during the enemy's approach and unable to prevent it from re-occupying all the positions whence it had been expelled. On the other hand the wiser regimen gives vigour to circulation, respiration, and digestion, increases strength of will and purpose, and makes the attack on such undue deposits of fat as may remain not only effective but pleasant work. And the good habits by which this result has been obtained are not likely afterwards to be dropped,—at least, to be dropped long enough to allow undue obesity to return.

But other correspondents ask whether in middle and advanced life either the regimen or the special exercises which we recommend for the increase of strength or (where necessary) for the reduction of weight, can be pursued. We answer unhesitatingly that they can, due regard being had to such moderation as experience and common sense alike enjoin.

As an introduction to the remarks we propose to make on this part of our subject, we quote a letter from a man who was eminent for literary ability and business capacity, who lived a full life as well as a long life, and who wrote what we are about to quote at the age of seventy-seven:—

"I promised some time since," wrote the poet Bryant to a friend in 1871, "to give you some account of my habits of life, so far at least as regards diet, exercise, and occupations. I am not sure that it will be of any use to you, although the system which I have for many years observed seems to answer my purpose very well. I have reached a pretty advanced period of life without the usual infirmities of old age, and with my strength, activity, and bodily faculties generally in pretty good preservation. How far this may be the effect of my way of life, adopted long ago, and steadily adhered to, is perhaps uncertain.

"I rise early; at this time of the year about half-past five; in summer, half an hour or even an hour earlier. Immediately, with very little encumbrance of clothing, I begin a series of exercises, for the most part designed to expand the chest, and at the same time call into action all the muscles and articulations of the body. These are performed with dumb-bells (the very lightest, covered with flannel), with a pole, a horizontal bar, and a light chair swung around my head. After a full hour, and sometimes more, passed in this manner, I bathe from head to foot. When at my place in the country I sometimes shorten my exercises in the chamber, and going out, occupy myself for half an hour or more in some work which requires brisk exercise. After my bath, if breakfast be not ready, I sit down to my studies till I am called. . . . . . After breakfast I occupy myself for awhile with my studies, and then, when in town, I walk down to the office of the *Evening Post*, nearly three miles distant, and, after about three hours, return, always walking, whatever be the weather or the state of the streets. In the country I am engaged in my literary tasks till a feeling of weariness drives me out into the open air, and I go upon my farm or into the garden and prune the fruit-trees, or perform some other work about them which they need, and then go back to my books. I do not often drive out, preferring to walk."

Seven years later, soon after Bryant's death at the age of eighty-four years, Mr. William G. Boggs, who knew the poet intimately for many years, gave the following reminiscences to a representative of the *Evening Post*:—

"During the forty years that I have known him Mr. Bryant has never been ill—never been confined to his bed, except on the

occasion of his last accident. His health has always been good. Mr. Bryant was a great walker. In earlier years he would think nothing of walking to Paterson Falls and back, with Alfred Pell and James Lawson, after office hours. He always walked from his home to his place of business, even in his eighty-fourth year. At first he wouldn't ride in the elevator. He would never wait for it, if it was not ready for the ascent immediately on his arrival in the building. Of gymnastic exercises he was very fond. Every morning, for half an hour, he would go through a series of evolutions on the backs of two chairs, placed side by side. He would hang on the door of his bedroom, pulling himself up and down an indefinite number of times. He would skirmish around the apartment after all fashions, and once he told me even "under the table." Breakfast followed, then a walk down town; and then he was in the best of spirits for the writing of his editorial article for that day. . . . . He was a constant student. His daily leading editorial constituted, and was for many years, the *Evening Post*. Sometimes he would not get it written until one o'clock. 'Can't I have it earlier?' I asked him one day. 'Why not write it the evening before?' 'Ah,' he replied, 'If I should empty out the keg in that way, it would soon be exhausted.' He wanted his evenings for study. 'Well, then, can't you get down earlier in the morning?' He said, 'Oh yes.' A few months afterwards he exclaimed, with reference to the change: 'I like it.' I go through my gymnastics, walk all the way down, and when I get here I feel like work. I like it.'"

Mr. Boggs also stated that Mr. Bryant's sight and hearing were scarcely impaired even up to his death.

(*To be continued.*)

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XV.

In addition to the beliefs in the transformation of men into animals and in the transmigration of souls into the bodies of animals, we find among barbarous peoples a belief which is probably the parent of one and certainly nearly related to both, namely, in descent from the animal or plant, more often the former, whose name they bear. Its connection with transmigration is seen in the belief of the Moquis, an Indian tribe, that after death they live in the form of their totemic animal, those of the Deer family becoming deer, and so on through the several clans. The belief survives in its most primitive and vivid forms among two races, the aborigines of Australia and the North American Indians. The word "totemism," given to it both in its religious and social aspects, is derived from the Algonquin "dodaim" or "dodhaim," meaning "clan-mark." Among the Australians, the word "kobong," meaning "friend" or "protector," is the generic term for the animal or plant by which they are known. It is akin in significance to the Indian words "manitou," "oki," &c., comprehending "the manifestations of the unseen world, yet conveying no sense of personal unity," which are commonly translated by the misleading word "medicine;" hence, "medicine-men."

The family name, or second name borne by all the tribes in lineal descent, and which corresponds to our surname, *i.e.*, *super nomen*, or "over-name," is derived from names of beasts, birds, &c., around which traditions of their transformation into men linger. Sir Geo. Grey* says that there is a mysterious connection between a native and his kobong. It is his protecting angel, like the "daimon" of Socrates, like the "genius" of the early Italian. "If it is an animal, he will not kill one of the species to which it belongs, should he find it asleep, and he always kills it reluctantly and never without affording it a chance of escape. The family belief is that some one individual of the species is their dearest friend, to kill whom would be a great crime," as, in Hindu belief, when a Rajah was said to have entered at death into the body of a fish, a "close time" was at once decreed. Among the Indian tribes we find well-nigh the whole fauna represented, their totem being the Bear, Turtle, Deer, Hawk, Eagle, Pike, Buffalo, &c. Like the Australians, these tribes regarded themselves as being of the breed of their particular animal-totem, and avoided hunting, slaying and eating (of which more presently) the creature under whose form the ancestor was thought to be manifest. The Chippeways carried their respect even further. Deriving their origin from the dog, they at one time refrained from employing their supposed canine ancestors in dragging their sledges. The Bechuana and other people of South Africa will avoid eating their tribe-animal or wearing its skin. The same prohibitions are found among tribes in Northern Asia, and the Vogulitzi of Siberia, when they have killed a bear, address it formally, maintaining "that the blame is to be laid on the arrows and iron, which were made and forged by the Russians!" Among the Delawares the Tortoise gens claimed supremacy over the others, because their ancestor, who had become a fabled monster in their mythology, bore their world on his back. The Californian Indians are in interesting agreement with Lord Monboddo when, in claiming descent from the prairie wolf, they account for the loss of their tails by the habit of sitting, which, in course of time, wore them down to the stump! The Kickapoos say their ancestors had tails, and that when they lost them the "impudent fox sent every morning to ask how their tails were, and the bear shook his fat sides at the joke." The Patagonians are said to have a number of animal deities, creators of the several tribes, some being of the caste of the guanaco, others of the ostrich, &c. In short, the group of beliefs and practices found among races in the lower stages of culture point to a widespread common attitude towards the mystery of life around them. In speaking of totemism among the Red Races, Dr. Brinton thinks that the free use of animate symbols to express abstract ideas, which he finds so frequent, is the source of a confusion which has led to their claiming literal descent from wild beasts. But the barbaric mind bristles with contradictions and mutually destructive conceptions; nothing is too wonderful, too *bizarre* for its acceptance, and the belief in actual animal descent is not the most remarkable or far-fetched among the articles of its creed.

The subject of totemism is full of interest both on its religious and social side:—

On its religious side it has given rise, or, if this be not conceded, impetus, to that worship of animals which assuredly had its source in the attribution of mysterious power through some spirit within them, making them deity incarnate.

On its social side it has led to prohibitions which are inwoven among the customs and prejudices of civilised communities. But, before speaking of these prohibitions, the barbaric mode of reckoning descent should be noticed.

The family name borne by any Australian tribe is perpetuated by the children, whether boys or girls, taking their mother's name. Precisely the same custom is found among the American Indians—the children of both sexes being of the mother's clan. Now, the family, as we define it, does not exist in savage communities, nor, as Mr. McLennan says in his very remarkable work on "Primitive Marriage," had "the earliest human groups any idea of kinship, . . . the physical root of which could be discerned only through observation and reflection." Where the relations of the sexes were confused and promiscuous, the oldest system in which the idea of blood-ties was expressed

* "Travels in N.W. and W. Australia," Vol. II., 229.

was a system of kinship through the mother. The habits of the "much-married" primitive men made mistake about any one's mother less likely than mistake about his father; and, if in civilised times it is, as the saying goes, a wise child that knows its own father, he was, in barbarous times, a wise father who knew his own child. Examples tracing the kinship through females, father and offspring being never of the same clan, abound in both ancient and modern authorities, and perhaps the most amusing one that can be given is found in Dr. Morgan's "Systems of Consanguinity." He says that the "natives of the province of Keang-se are celebrated among the natives of the other Chinese provinces for the mode, or form, used by them in address, namely, 'Laon peaon,' which, freely translated, means, 'Oh, you old fellow, brother mine by some of the ramifications of female relationship!'"

The prohibitions arising out of totemism are two: 1. Against intermarriage between those of the same name or crest. 2. Against the eating of the totem by any member of the tribe called after it.

1. Among both Australians and Indians a man is forbidden to marry in his own clan, *i.e.*, any woman of his own surname or badge, no matter where she was born or however distantly related to him.

Were this practice of "Exogamy," as marriage outside the tribe is called, limited to one or two places, it might be classed among exceptional local customs based on a tradition, say, of some heated blood-feud between the tribes. But its prevalence among savage or semi-savage races all the world over points to reasons the nature of which is still a *crux* to the anthropologists. The late Mr. McLennan, whose opinion on such a matter is entitled to the most weight, connects it with the custom of female infanticide, which, rendering women scarce, led at once to polyandry, or one female to several males, within the tribe, and to the capturing of women from other tribes. This last-named practice strengthens Mr. McLennan's theory. He cites numerous instances from past and present barbarous races, and traces its embodiment in formal code until we come to the mock relics of the custom in modern times—as, for example, that harmless "survival" in bride-lifting, that is, stealing, as in the word "cattle-lifting."

Connected with this custom is the equally prevailing one which forbids intercourse between relations, as especially between a couple and their fathers and mothers-in-law, and which also forbids mentioning their names. (I have, by the way, heard more than one cynical son-in-law express regret that certain features of this custom had not survived among ourselves.) So far as the aversion which the savage has to telling his own name, or uttering that of any person (especially the dead), or thing feared by him is concerned, the reason is not far to seek. It lies in that confusion between names and things which marks all primitive thinking. The savage, who shrinks from having his likeness taken in the fear that a part of himself is being carried away thereby, regards his name as something through which he may be harmed. So he will use all sorts of roundabout phrases to avoid saying it, and even change it that he may elude his foes, and puzzle or cheat Death when he comes to look for him. But why a son-in-law should not see the face of his mother-in-law, for so it is among the Aranaks of South America, the Caribs and other tribes of more northern regions, the Fijians, Sumatrans, Dayaks, the natives of Australia, the Zulus, in brief, along the range of the lower culture, is a question to which no satisfactory answer has been given, and to which reference is here made because of its connection with totemism.

II. That the animal which is the totem of the tribe should not be eaten, even where men did not hesitate to eat their fellows, is a custom for which it is less hard to account. The division of flesh into two classes of forbidden and permitted, of clean and unclean, with the resulting artificial liking or repulsion for food which custom arising out of that division has brought about, is probably referable to old beliefs in the inherent sacredness of certain animals. The Indians of Charlotte Island never eat crows, because they believe in crow-ancestors, and they smear themselves with black paint in memory of that tradition; the Dacotahs would neither kill nor eat their totems, and if necessity compels these and like barbarians to break the law, the meal is preceded by profuse apologies and religious ceremonies over the slain. The abstention of the Brahmins from meat, the pseudo-revealed injunction to the Hebrews against certain flesh-foods (that against pork has its origin, it has been suggested, in the tradition of descent from a boar) need no detailing here. But, as parallels, some restrictions amongst the ancient dwellers in these islands are of value. It was, according to Cæsar,* a crime to eat the domestic fowl, or goose, or hare, and to this day the last-named is an object of disgust in certain parts of Russia and Brittany. The oldest Welsh laws contain several allusions to the magical character of the hare, which was thought to change its sex every month or year, and to be the companion of the witches, who often assumed its shape.† The revulsion against horseflesh as food may have its origin in the sacredness of the white horses, which, as Tacitus remarks,‡ were kept by the Germans at the public cost in groves holy to the gods, whose secrets they knew, and whose decrees regarding mortals their neighings interpreted. That this animal was a clan-totem among our forefathers there can be no doubt, and the proofs are with us in the white horses carved in outline on the chalk hills of Berkshire and the west, as in the names and crests of clan descendants.

The survival of the totem in heraldry is worth more than a passing remark, and will have further reference in a succeeding chapter.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.§

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(*Continued from page* 140.)

Nearly every one must have noticed that when you are in an inland road near the sea, at a considerable height above the sea-level, you are apt when you get a sudden view of the sea-horizon to find it much higher than you had expected. This is particularly the case if there are steep side-tracks leading down towards the sea from the road you are following and if you have had reason to note the steepness and depth of these side-tracks as you advance, without however seeing the sea itself for some time. Then when you come upon an opening leading to the sea, you look *down* for the sea-horizon and find that you must turn your eyes upwards to see it: not upwards in reality, nay

* "De Bell. Gall.," V., c. 12.

† Elton's "Origins of English History," p. 297.

‡ Germania, IX., 10.

§ I beg to state that those are entirely mistaken who imagine that these papers are intended for the benefit or instruction of the flat earth paradoxers. They are meant entirely for those who know the earth to be a globe, but (like myself) take interest in noting simple proofs of the fact.

in reality somewhat though not perceptibly downwards, but upwards from the direction in which you had first looked expecting to see the horizon.

This is by many regarded rather as a difficulty than as a proof of the earth's rotundity. Yet no one can look at the sharply defined sea-horizon as seen from a considerable height, under favourable atmospheric conditions, without seeing at once that that sharpness of definition is inconsistent with flatness. When far beyond the sea-horizon land is in view, the contrast between the distinctness of the sea-horizon and the indistinct hazy look of the land beyond affords another striking evidence of the rotundity of the sea-surface, for it shows that there is more haze between the eye and the land than there is between the eye and the part of the sea-surface where the sea-horizon line is formed.

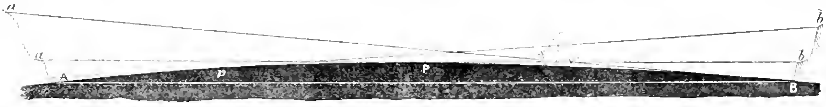


Fig. 15.

Thus if *a* (Fig. 15) be the place of an observer, A the sea-level beneath him, and *a* P *b* the line of sight touching the sea-horizon at P, and extending onwards to the cliffs at *b*, we are not merely convinced but feel instantly that P is much nearer than *b*, when we find that the sea-horizon at P is seen much more clearly than the cliffs at *b*. We know then that the surface must round itself above the straight line A B in order to have this relative nearness at P.

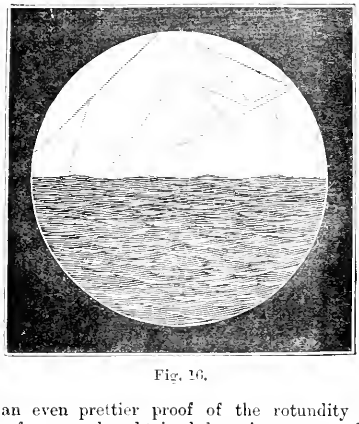


Fig. 16.

But an even prettier proof of the rotundity of the water-surface may be obtained by using a powerful telescope at a station such as *a*, and directing it upon the horizon-line at P towards a ship as at *s*. It will be found that when the telescope is focussed so as to show the sea-horizon distinctly, the masts and sails of the ship *s* are seen indistinctly. Fig. 16 gives an idea of what is seen. To bring the ship sharply into view, the focussing rack-work must be used so as to carry in the eye-tube, as for a more distant object, and then presently the parts of the rigging in view are seen sharply defined as in Fig. 17, while the sea-horizon has become hazy and indistinct. Where a low magnifying power is employed on a large telescope, so that the focal range for different distances is relatively great, this observation is singularly effective. I have never known any one who has ever tried it under good observing conditions without finding that strong though his faith might already have been in the rotundity of the earth, it was much confirmed and strengthened by this particular observation. It makes the observer *feel* as it were that the sea surface rises in a bold sweep between him and the more distant object seen in the same field of view.

But this way of recognising the sea's rotundity may be improved upon. Let us suppose that our observer starts from A, to climb up the cliff (along the roadway will do very well) till, after passing the level *a*, he reaches the summit of the cliff at *a'*.

When he is at A the line of sight to the sea-horizon meets the sea curve close by as at *p* and the clearness of the sea-line, supposing the observation made in good observing weather, is very striking, as is also the contrast between the sharp definition of the sea surface at *p* and the haziness of the cliff at *b'* if that is visible at all, as of a ship at *s*. If the telescope is used as in the experiment just described, at such a station as A, the amount of focussing required to correct from a clear sea-horizon into well defined ship rigging, or *vice versâ*, is much greater than when the telescope is set higher above the sea-level.

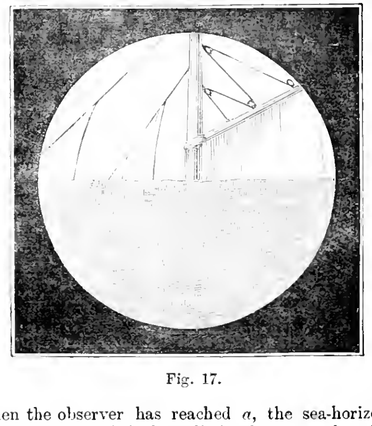


Fig. 17.

When the observer has reached *a*, the sea-horizon has retreated to P, and is less distinctly seen, though it is very marked against the distant cliff at *b*. But when, passing onwards to *a'*, he brings the sea-horizon to B or even further from him, so that he sees to the very foot of the cliff, then the sea-horizon (on either side of the cliff B *b b'* (which we suppose to be a cape projecting towards him) is no longer seen to be freer from the effects of haze that the cliff's face at *b*. If the observer has noted the sea-horizon from time to time during his ascent he will have seen (presuming the weather remains tolerably constant) that the sea-horizon gets lighter and lighter in tone as he passes higher and higher, showing that it passes farther and farther away and is thus more and more affected by the presence of any haze that may be in the air

For even in the clearest weather there is always enough haze near the sea-level to affect the distinctness of the sea-horizon, when, owing to the observer's ascent, it is thrown twenty or thirty miles away.

(*To be continued.*)

THE FISHERIES EXHIBITION.

By John Ernest Ady.

VI.

LET us now look a little higher in the scale of sponge life. We find sponges which strongly resemble the simple *Ascetta** already described; they go a step further to form the family *Leucones*, of which *Leucon* (Fig. 13, D) is a type. The advance in structural complexity consists in this,—that the ectoderm or syncytium becomes greatly thickened, and, as a consequence, the simple pores which

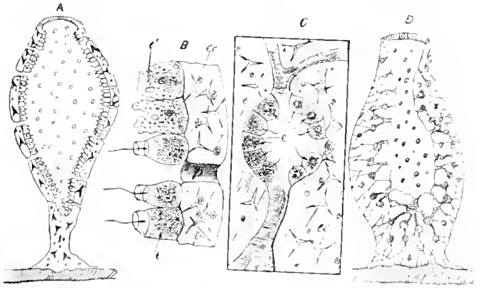


Fig. 13.—Diagrams to show the structure of ASCONES and LEUCONES. A, *Ascetta primordialis*, one of the ASCONES. B, Portion of the body-wall of the same highly magnified to show *e c*, ectodermal syncytium with spicules; *e*, flagellate cells of endoderm; *e'*, endodermal cells without flagella; *p*, an inhalent pore. D, *Leucon*, to show greatly thickened syncytium with branched anastomosing canals, and ciliated chambers. C, One of the ciliated chambers of *Leucon* highly magnified; *e c*, the syncytium; *e*, endodermal cells of ciliated chamber.

lead into the body cavity of *Ascetta* (which is typical of its family, the *Ascones*) are here converted into long tubes, which may branch, and unite at intervals. The endodermal ciliated cells, moreover, do not now form a continuous layer lining the body cavity, but are parcelled out into groups which everywhere stud dilatations in the branching tubes. These dilatations are known as the *ciliated chambers* (Fig. 13, C; Fig. 14, *c*) or *ciliated baskets* of the sponge, and are the representatives of the once continuous endoderm.

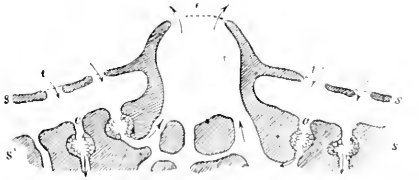


Fig. 14.—Hypothetical section of a *Spongilla*. *s*, superficial layer; *s'*, deeper substance of sponge; *i*, inhalent apertures; *e*, exhalent aperture; *c*, ciliated chambers. The arrows indicate the direction of the currents. (After Huxley.)

* *Ut supra*, p. 124.

In *Spongilla fluviatilis*, the common fresh-water sponge, a growth something like that which has just been noted is developed as shown in Fig. 14, but with this difference, that in place of the calcareous spicules of the *Leucones* there is a fibrous skeleton of keratose strengthened with spicules of silica, which are also scattered amongst the sponge-cells, or *sarcoids*, as the latter are sometimes called. In the curious *Halisarca* we have a sponge identically similar, but entirely devoid of a skeleton; it has therefore been placed in a division by itself, the *Myxospongia*. In the sponges of commerce also (*Spongia*), the main difference lies in the nature of the skeleton, which is wholly fibrous and composed of keratose. The beautiful siliceous sponges, *Euplectella* and its allies, are likewise all resolvable into the type of structure which has now been explained.

There is one peculiar process which we have before alluded to as an aberrant phase in the life-history of *Spongilla* to which we would now draw attention, as of importance to those who desire to follow its interesting details practically.* During the autumnal months several contiguous cells in the body of the sponge lose their ordinary appearances, and acquire bright granules, which finally obscure their other characteristics. The cells immediately surrounding the group so formed, unite to produce a kind of coat for them, and secrete in this a skeleton of keratose. Each central cell now develops a peculiar siliceous spicule, resembling two toothed-wheels united by an axle (Fig. 15). A small opening, or *hilum*, is left at one

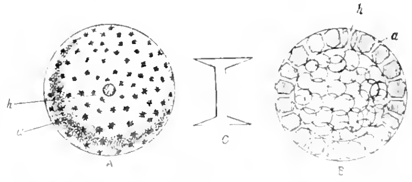


Fig. 15.—*Spongilla fluviatilis*.—A, so-called "seed" or "gemmule," external aspect showing hilum, *h*, and toothed tops of spicules or amphidises. B, diagrammatic section of gemmule, showing position of amphidises, *a*; *h*, hilum. C, amphidise seen in profile (after Nicholson).

part of this *amphidiscus*: its protoplasm dwindles away till nothing but the outer keratose coat and the peculiar spicules, arranged perpendicularly to the surface, as in Fig. 15, remains. This condition is arrived at in winter, and the bodies, now known as *sponge seeds*, remain thus during the cold months. On the advent of spring, however, the internal cells resume their activity, are extruded from the hilum, and settle down to develop into a young *Spongilla*.

Lastly, there is a genus of sponges which bore into the shells of molluscs by means of curiously-shaped siliceous spicules, and live there parasitically; these *Clionidæ* have been found in some of the oldest geological formations, *e.g.*, from the Silurian upwards. Their anatomy, and therefore their affinities, has not yet been determined.

We cannot here enter into the details of the arguments respecting the affinities of the sponges. Suffice it to say, that the weighty evidence of the formation of a blastoderm, and its subsequent passages through the morula, gastrula, and other stages, is sufficient to place the group of sponges (*Porifera*) nearer the *Cœlenterata* than the *Protozoa*. This will become apparent when we have defined what a cœlenterate animal is; but, to avoid confusion, we must

* *Spongilla* may be obtained from Mr. G. H. King, 165, Great Portland-street, W.; or from Mr. Thomas Bolton, of 57, Newhall-street, Birmingham, both of whom have shown specimens at their stands in the Exhibition.—J. E. A.

not anticipate matters here. We may merely remark that the presence of *thread-cells* detected by Eimer* in certain sponges (*Renierida*) helps largely to support these conclusions.

Before we leave the subject of the sponges let us look a little more in detail at one of the beautiful siliceous forms (*Euplectella*), which finds so deservedly attractive a place in the Exhibition buildings. The first specimen of this sponge was brought to this country from the Philippines for the Zoological Society, and was carefully described with figures by the distinguished Director of the British Museum in the "Transactions" of that Society.† Dr. Owen supposed that the upper broad end was buried in the sea bottom, and that the smaller extremity, with its tuft of fibres, was its upper free portion. It is now known that the reverse of this is actually the case, and that the fibrous narrow extremity anchors the sponge to the substratum. In Lady Brassey's case there are also a few examples of another beautiful sponge, commonly known as the glass-rope sponge (*Hyalonema*), and, strange to relate, it also was long represented upside-down, with its glassy rope of siliceous fibres spreading out above, instead of serving to fix the sponge to the bed of the ocean. Both of these lovely organisms, *Euplectella* and *Hyalonema*, belong to the same group of siliceous sponges, the *Hexactinellidæ*, so called because their spicules are primarily six-rayed.

Circumstances of great interest to naturalists may be observed in both *Euplectella* and *Hyalonema*. In the former, it often happens that the body-cavity contains species of curious crustaceans, and it was thought that the poor little creatures were "the insects" which produced the exquisite sponge. The presence of the crab within the body-cavity of the sponge, however, serves to illustrate a very peculiar and important occurrence in Nature, known as *commensalism*. The crab does not live *at the expense* of the sponge, and is not therefore a *parasite*; it merely lives *with* the sponge at a place best adapted to the provision of its wants. It commenced its existence within the sponge as an egg or young animal taken into the body-cavity with other food; instead of being digested, it survived, and grew there into an adult crab, living upon materials brought to it by the sponge; it received all the necessary wants of life in a comparatively secure retreat, and transmitted the peculiarities, whereby it was enabled to survive, to its offspring, fitting them to take up their abode within the same or some other *Euplectella*. Here we have an excellent example of the survival of the fittest. Now, if we look at *Hyalonema*, we shall observe in most specimens that the glassy rope is covered over with a brown incrustation. When perfectly fresh, this outer brown coating is resolvable into a number of closely adherent sea anemones of the genus *Palythoa*. To *Palythoa* the fabrication of the sponge was once attributed; but careful researches into its structural relations has shown that *Palythoa*, like Euplectella's crab, is only a commensal.

For many years Venus's flower-basket was considered to be a very rare organism, and found a place only in the cabinets of the wealthy; specimens can now be procured at from four to ten shillings each. The demand for specimens made the fishermen of the Philippines very zealous about concealing their hunting-grounds, and Professor Owen, in describing the capture of the type specimen,‡ said that it was reported to have been obtained off the island of Bohol, at a depth of ten fathoms, and on a rocky bottom. All subsequent experiences show that *Euplectella* lives only on a soft muddy bottom, at depths, according to Captain Chimmo, of from 120 to 140 fathoms.* In the voyage of the *Challenger*, numerous examples were procured off the island of Zebu, at from 95 to 100 fathoms, and only one solitary form (*Euplectella suberea*), with fragments of others, have been described by the late Sir Wyville Thomson† as coming from a depth of 1,090 fathoms in the Atlantic Ocean, ninety miles south-east of Cape St. Vincent.

* "Nesseizellen und Saamen bei See-Schwämmen," Arch. für Mik. Anat., Bd. viii., 1872.

† Vol. iii. 1841, p. 203.

‡ "Transactions of the Linnæan Society, 1857." Vol. xxii.

* "Natural History of *Euplectella aspergillum*." By William Chimmo. (London. 1878.)

† "Voyage of the *Challenger*,—The Atlantic," Vol. i., p. 133.

The American *Granite Cutters' Journal* says:—"From surveys and calculations made by Mr. J. A. Farrington, civil engineer, the famous Washington boulder, near Conway Corner, N.H., is found to measure 30 ft. in height, 46 ft. in length, 35 ft. in width, and to weigh 3,867 tons. This is the largest known isolated piece of granite in the world."

The Washington correspondent of the Cleveland *Leader* writes:—"The Washington monument is the wonder of Washington, and its beauty the admiration of both Americans and foreigners. Already over 350 ft. high, it rises from the banks of the Potomac a great white marble shaft, piercing the clouds, and backed against the blue of the sky. It is already the grandest obelisk the world has ever seen, and in the æons of the future, should the nations of the day pass away, leaving no more records of their progress than the mighty ones of the Egyptian past, it will surpass the Pyramids in the wonder of its construction. It is already higher than the Third Pyramid, and within 100 ft. of the size of the second. It is taller than St. Paul's Cathedral, and when finished it will be the highest structure in the world."

Sport and Science.—Medical science has for centuries experimented on live animals for the purpose of obtaining increased knowledge of the laws of health and disease in the human body. That often unnecessary researches of this kind have been prosecuted is probable enough; and, unfortunately, it is but too certain that many who have, perhaps, begun such researches with no other wish but to extend knowledge, have grown not merely callous but cruel. In other words, it is certain that the practice of vivisection, which is a very old practice, has been subject to abuses. Yet the legislation by which medical researches conducted on the bodies of living animals have been restricted, has not altogether commended itself to the approval of men of science. In this country most of the restrictions were not required, and were little short of insults to the medical profession. Some of the restrictions also have proved mischievous in their operation. Be this as it may, it has been shown that the Legislature can deal with the wrongs of animals when only the researches of a learned profession are in question. It is otherwise when the sports by which our idlers amuse themselves are involved. The wretched sport of pigeon-shooting, as worthy of support as the street lout's practice of flinging stones at cats and dogs, receives protection from the House of Lords Temporal and Spiritual; the latter indeed not positively voting in favour of the right of grown men to shoot at wretched half-winged pigeons, but by carefully abstaining from voting serving equally well the purpose of the wretched beings who find sport in pigeon-shooting, whether in the cruel work itself or in looking on at it.—Mr. R. A. Proctor in the *Newcastle Weekly Chronicle*.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. V.—BREAD-MAKING (*Continued*).

In our last paper an explanation was given of how by the action of fermentation the dough becomes charged with carbon dioxide gas. Let us be quite sure that this action is understood ; certain minute organisms possess the power, under proper conditions, of effecting the decomposition of sugar into alcohol and carbon dioxide. When moist flour is exposed to air, seeds of the particular organism, which is a very low form of plant life, fall on the mass and fructify there. The flour is now changed into "leaven," and if a little be added to a further quantity of flour and water, the whole mass begins to ferment—that is to say, the growth of this plant proceeds through the whole, and sets up an active conversion of the sugar.

From the earliest times this method of causing dough to "rise" has been in common use, a portion of the one parcel of dough being set aside as leaven for the next. The coarser varieties of bread, particularly the German black bread, are still made in this fashion. For the finer varieties of bread beer-yeast is now largely used. There are two forms of this substance known in England—brewers' yeast and "German" or "dry yeast." This latter is simply brewers' yeast from which most of the water has been squeezed out, leaving a slightly moist greyish mass. Dry yeast consists almost entirely of the cells of this particular alcohol-producing plant whose action we have been studying. It has the advantage over leaven of being more concentrated and of greater purity.

In making bread with yeast, a small quantity of flour, yeast, and warm water are mixed together, and set aside in a warm place to undergo fermentation. This constitutes the "sponge"; with yeast in a healthy condition the dough is seen to rise, and bubbles of carbon dioxide from time to time escape. The sponge is next mixed with the main quantity of flour and water, and the whole mass thoroughly kneaded with the hands, and sometimes with the feet. The dough is now allowed to remain for some hours, the fermentation going on all the time ; it is next cut into loaves ; these go on fermenting until their size is nearly doubled ; they are then baked, and still further increase in volume through the expansion of the gases under the influence of heat. The heat of the oven rapidly arrests the fermentation by killing the yeast plant.

On the continent the making of bread has attained greater perfection than in England ; Paris and Vienna are justly renowned for the excellence of the bread there made. Their method of proceeding differs considerably from that in use with us. A portion of the dough from one baking is reserved for the next, and after remaining for about ten hours, is mixed with an equal quantity of freshly-made dough ; this, after standing some hours, is again kneaded with a larger quantity of fresh dough, and after another interval is mixed with more dough and also some beer yeast. About half of the fermented dough is made into loaves, which, after a time are baked. The remainder is mixed with more fresh dough and yeast, allowed to ferment, again divided, the half being baked, and the rest mixed with more dough and yeast. This division and re-fermentation is altogether repeated some five or six times ; the bread last produced is of the finest and whitest quality.

It will be seen that by the method of fermentation the carbon dioxide is produced at the expense of the sugar, and indirectly of the starch of the grain ; the loss, however, ut a very small one, for 1 oz. of sugar yields when fermented about twelve pints, or 400 cubic inches of carbon dioxide.

With good flour the operation of baking produces but little change in the composition of the interior of the loaf : the starch will be found to have undergone but little alteration, a small proportion will have been rendered soluble, but the greater number of granules have not even had their walls broken, being simply swollen by the absorption of water. As may be imagined, the quantity of this compound present in bread is considerable ; from the results of analyses of twenty-five different loaves Dr. Odling arrived at a mean of 43·43 per cent. of water. But although the "crumb" of the loaf is but little changed, there is a decided alteration in the crust. In the first place, it has a much sweeter taste, and, secondly, by proper treatment, yields a sticky substance. These characters point respectively to the conversion of starch into sugar and dextrin. These bodies may be extracted from the crust by soaking it in hot water, and then gently evaporating the clear solution. Under the influence of the greater heat to which the exterior of the loaf is exposed, the starch has suffered decomposition. When bread is "burnt," the decomposition has gone a step or steps further ; provided the heat has not been too intense, the sugar is converted into "caramel." This is the material used so largely for browning gravies and other similar purposes. In composition caramel consists of a number of closely-allied substances produced by the evolution of water from the sugar in various proportions. As the intensity of the heat is increased, the sugar gets more and more changed, until at last only charcoal remains. It will be of interest here to mention the composition of a sample of good bread : After first removing as much of the water as possible, the following results were obtained :—sugar, 3·6 ; altered starch, 18·0 ; unaltered starch, 53·5 ; gluten, with a little starch, 20·7 per cent.

Bread when new is very different to the same article when a few days old ; instead of being soft and spongy, a loaf will have become hard and almost brittle. The taste too will have altered, and that, with most peoples' palates, for the worse. The bread is usually supposed to have become dry ; and certainly the cracks which score a cut surface are suggestive of a loss of moisture. On weighing the bread it will be found, though, not to have lost much ; and what is far more striking, if the bread be re-baked, it again acquires the pleasant qualities of "new" bread. An experiment of re-baking stale bread showed it to have actually lost over 3 per cent. in the oven, so that, with less water, the bread had lost the peculiar dryness of taste. It is necessary, therefore, to go a step further in order to explain the change the bread has undergone in becoming stale : the water is still there, but instead of being in the free state, has gradually combined with certain of the compounds present, probably the starch. A gentle heat again decomposes these compounds, and the liberated water gives newness to the loaf.

We have so far been supposing that the flour used in bread-making is perfectly sound and of the best quality. Failing these conditions, other chemical changes occur by which the bread is more or less deteriorated. We have from time to time referred to the starch-converting power of the nitrogenous matters of grain ; the bran, owing to the presence of cerealin, is particularly active in this respect. So, too, is gluten, after the flour has been exposed for some time to warmth and moisture. The change of starch to sugar by these bodies is not well understood ; there, is, however, no reason to believe that it resembles fermentation by being the work of some living organism. There is some confusion on this point,

because the older authorities class the whole series of changes together under the name of fermentation. At the risk of tautology we will again state that this term is now restricted to those changes produced by the presence of minute living organisms. Different organisms cause different kinds of fermentation—thus yeast produces alcohol, other organisms form acetic acid, lactic acid, &c. Not only does the gluten of damp flour acquire the power of converting starch, but it also frequently undergoes the peculiar fermentation productive of lactic acid. (Lactic acid is present in sour milk.) On using such flour for bread-making, the gluten attacks the starch of warm dough and produces sugar in large quantities. The result is that the bread, instead of being white, porous, and pleasant-flavoured, is dark-coloured and sodden. The sugar and acid may be recognised by the objectionable sweetish-sour taste of the bread.

Our next paper must deal with these morbid changes in bread, and methods of preventing them; particular reference will be made to the use of alum for this purpose.

FOLLY AND COURAGE AT NIAGARA*

THERE were daring men before Captain Webb, and, of course, they have found their way to Niagara. One jumped from the bridge, 192 feet, to the swirling current. For fifty feet he fell like a plummet. Then he turned over twice. At last he struck the water with an awful slap—what the boys call a "belly-whopper." After reading an account of a fatal accident, one of the numerous Mrs. Partingtons asked if the man died. So I say plainly this man died, probably before he reached the water. And yet, perhaps, that idea, too, has gone to meet the exploded legend of William Tell. But such little accidents only stimulate the reckless. Another jumper soon appeared, as soon another swimmer may. He wore a harness over his shoulders. To it was attached a wire, running loosely over a cylinder on the bridge. That kept his feet straight towards Davy Jones' locker, and he survived the leap, to his considerable personal profit. From bridge to water he went in four seconds—the only time on record. Another foolhardy feat was performed by some of the reckless men who decorate almost inaccessible landscapes with possibly truthful but most certainly inapropos puffs of ague pills, liver-pads, and such. A log once lodged forty rods above Goat Island. For four years it lay there, seemingly as beyond human reach as the North Star. It touched the pride of certain shameless and professional advertisers, who were famous for their vandalism, that such a chance should be wasted. So when the rapids were thinly frozen over they made their cautious way to the log, and soon there was a gorgeous sign fixed, twelve feet by four, a hideous eyesore, inescapable, on the very fore-front of one of the world's grandest spots, *i.e.* :—

GO EAST VIÂ LAKE WINNIPISEOGEE R. R.

Their deed almost met its deserts. They treated the log too roughly. A hole was made through the ice and the current soon did the rest. It was even betting that they would not get ashore. But they did. This was not a fatal accident.

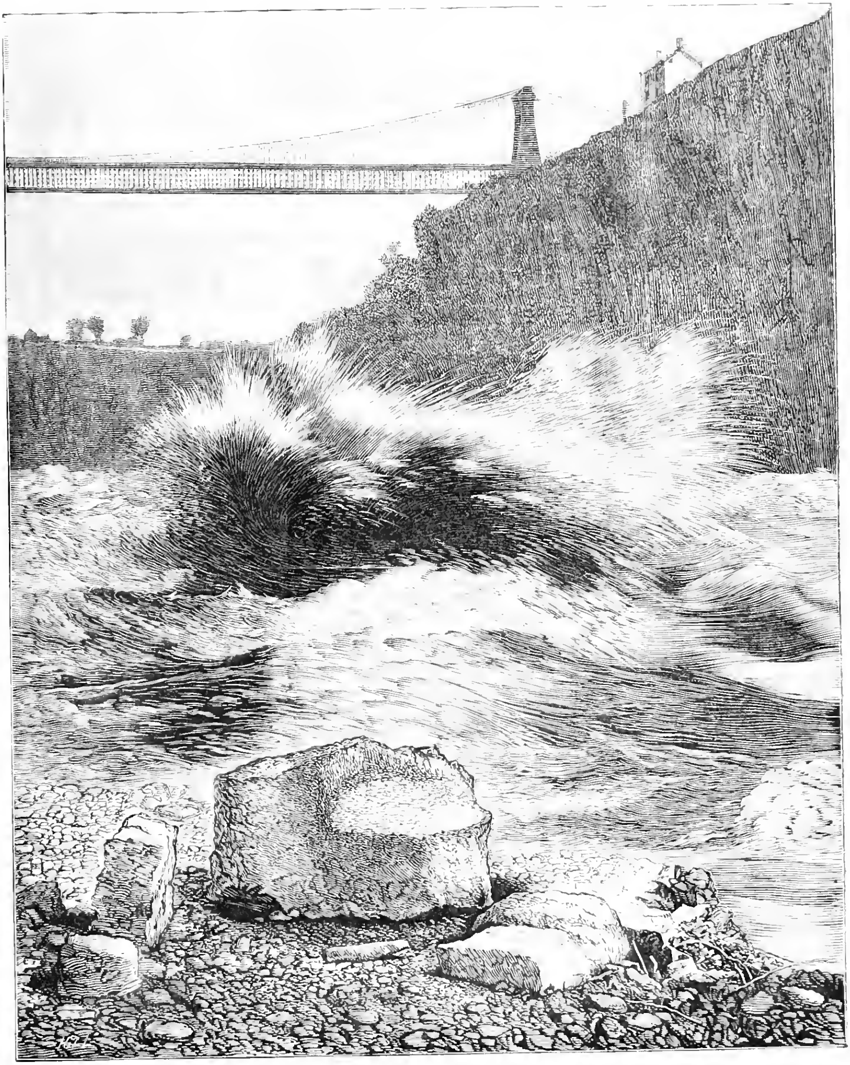
Of accidents some very strange ones are recorded. One lady stooped for a cup of water, lost her balance, and was out of reach and over the falls almost before her amazed husband knew what had happened. Another lady stooped to pluck a flower on the brink of Table Rock. She was taken up dead from the rocks below. A rhyming irreverent tourist on the same day recorded a bit of elegiac poetry that would have made him a man of mark in Philadelphia. He simply wrote :—

"At the early age of twenty-three
Was pitched into e-ter-ni-ty."

In 1875 an accident equally sad and foolish occurred. An engaged couple went behind the falls, into the Cave of the Winds, without a guide. The lady actually sought to bathe in a pool which even the guides never visited. Her lover lost his life in trying to save hers. Perhaps the most dramatic accident was the following: A playful young man caught up a charming child who was watching the tumbling waves. "Now, Lizzie, I am going to throw you into the water," he said, and swung her back and forth. She screamed, struggled, and slipped from his hands. He gazed after her, realised what he had done, and leaped. Rescue was hopeless. Perhaps he did not deserve death, and at least censure may die with him.

Of escapes, there are one or two narrow almost beyond belief, and which involve stories of skill and bravery well worth telling. Not many years ago a painter was at work on Second Sister's Island, when he fell into the water. He was old and weak, and while his position was not very dangerous at first, he soon floated down and toward midstream, when, just as he seemed hovering on the brink, and exactly forty feet from it, if contemporary records are to be believed, he caught on a rock. How long would his muscles endure the strain? And who would rescue him, and how? The crowd was helpless until a guide appeared with a coil of rope. One end he left in trusty hands, and with the other he plunged into the boiling tide. When he reached the poor painter the old man still held in his hand the putty-knife with which he had been working. He shifted the knife to his pocket, tied the painter to the rope, and they reached the shore safely. In another case a boatman was crossing the river above the falls, when a fog suddenly came up. He lost his bearings and knew he was drifting to death. His cries alarmed the village, and bells were rung for him to row toward them. Then an oar broke. His only hope then lay in a paltry little anchor and a common rope, which was, moreover, much worn. He examined every foot, nay, every inch of it; he tugged at the knots at each end. Time and space were precious, but he could not afford to make a mistake. Then he threw it over. It bumped along the stones, and his heart beat each time it failed to catch a grip. At last it caught, and brought the boat up standing while the tense string throbbed like the bass gut of a harp. For the moment it held. How soon would it part? He shrank from feeling along the strands. He was more afraid not to lest he should read his fate in the twine tense and twanging under the current. Inch by inch his fingers travelled to his arm's length. So long as he held there he was safe. Time and time again through the long night he did this, but never, he said, without a heart like lead and hands quivering like a leaf. When morning dawned, as at last it did, he was easily saved. In another case the danger to life, though considerable, was not imminent. A tug was towing three scows, when one went adrift. With admirable promptness and address the captain of the tug cut loose the rest of his tow and steamed ahead of the drifting barge. There he held it by steam power, and when the others came along a line was passed, the throttle was

* *New York Times*' Niagara Falls Letter.



THE WHIRLPOOL RAPIDS, NIAGARA.

(From an Instantaneous Photograph.)

thrown dead open, and it was sought to make way up stream. But they had drifted fairly within the grasp of the spirit of the waters, and for a time it seemed he would not let go his own. Finally a foot was gained, in a few minutes another, and then the tug of war was virtually over. An "escape" of another sort was that of a murderer. The Sheriff was behind him, the river in front, and only the wires of the old bridge at Lewiston to help him across. Hand over hand he began the passage. His hands quickly blistered, and then they bled. Again and again he rested his arms by hanging by his legs. At last he reached the opposite bank and lay panting full an hour before he continued his flight. The feat was certainly a remarkable one for an amateur.

AMERICAN MANNERS IN TRAVELLING.

By Richard A. Proctor.

Mr. Phil Robinson's diatribes, recently very widely circulated in English country newspapers, illustrate well the bias of patriotism. Consider the pleasing effects produced by this "highest of civic virtues" as thus manifested. (Some will say I am not writing about science; but in these days sociology has already begun to be a science, and it deserves to be regarded, and soon will be regarded, as among the most important of the sciences.) I do not know how long Mr. Robinson has been in America or how much he has travelled there; but even if he has been no longer there than the twenty months which, in all, I have passed in America, I should say it was very unlikely that he had travelled more than I in that country, seeing that during nearly all those twenty months I have been busily travelling from place to place, and sometimes for weeks in succession have averaged ten or twelve hours' travel per day. Let me in passing also note that so much hard travelling does not tend to encourage fair judgment of manners, &c, but rather to cause the traveller to look with jaundiced eyes on all or nearly all he sees. I may further add that to my own experience of American travelling ways, I can add those of members of my own family who have passed nearly their whole lives in that country. I find, however, that whereas Mr. Phil Robinson describes certain bad habits as characterising the travelling Americans generally, leading to the idea that at least nine out of ten Americans when travelling grab their food, and gorge and snort in ways too hideously unpleasant for repetition, I have never among all my fellow-travellers in America seen one single person afflicted with such evil habits (all at one time); and though I can cite one or two cases in which I have seen one particular bad habit of those mentioned by Mr. Robinson, two or three cases in which I have seen another, there are one or two of the evil habits which he attributes to Americans generally which I have never seen at all. Yet I am an observant traveller, very sensitive to sights and sounds and smells not altogether agreeable, and certainly ready enough to mention what I have noticed.

Supposing for a moment, though I think it utterly unlikely, that Mr. Robinson had in one single instance seen all the gross faults of manners which he attributes to all Americans when travelling—supposing (which I flatly deny, however) that some one of these faults could be seen in half, or a third, or a fourth, or even a tenth or twentieth of American travellers, still would it not have occurred to Mr. Phil Robinson, but for the bias of that "first of civic virtues," that if in England all classes had, as in America, to seek the same refreshment rooms and to sit at the same sets of tables, the observed instances of bad manners would be at least as numerous as I have imagined they might be (but deny that they are) in America? Of course, many will say that so far as comfort in travelling is concerned it matters nothing whether bad habits present themselves through a wrong system causing cultured and uncultured to be brought together, or through the prevalence of such habits. This would be a digression from the argument; but I believe the truth to be that the American system leads to a diminution of otherwise prevalent bad habits—for ninety-nine hundredths of the so-called lower class in America will *not suffer* any inferiority to be shown in their habits in the presence of those whom they regard as no otherwise better than in having more money to spend. But be this as it may, a fair, unbiassed comparison of the manners of the travelling community, class for class, or comparing the whole number of travellers, would show that —in some way or another—a marvellous superiority has arisen on the other side of the Atlantic. Such offences as the stolid, stupid, staring so common here even among well-to-do people, rudeness to women or children, carelessness as to the comfort of the old and weak, and so forth, are scarcely ever seen on the other side of the Atlantic. If I were an American, with what "pride in my port, defiance in my eye" should I be tempted to boast that a young, inexperienced, and pretty girl, poor or rich, in her teens, can travel across the length and breadth of the United States alone and unprotected, not only in perfect safety and comfort, but with the certainty that nine-tenths of the men—of all classes—with whom her journey brings her into contact, esteem it equally a duty and pleasure to assist her in every possible way. How contemptuously I might be tempted to remind the Briton that—for reasons too well known—the most courteous and well-meant proffer of assistance to such a traveller in this country is apt to be looked on with suspicion. On the Continent, and especially in France, it is even worse.—*Newcastle Weekly Chronicle.*

Insulating Wires.—A composition for insulating wires has been recently patented, which is made up as follows:—By mixing ozokerit with blacklead, carefully dried, and guttapercha in the proportions of about ·3 of ozokerit to 10 parts black lead and 15 guttapercha. The properties of the constituents do not by any means augur success.

New Source of Caoutchouc.—The attention of the Indian Government has been drawn to a new plant, which is common in southern India, and yields abundant supplies of pure caoutchouc. It is an apocynaceous plant called *Prameria glandulifera*, the native habitat of which appears to be in the forests of Cochin China, where the liquid juice is often employed in medicine by the Annamites and Cambodians. When broken, the twigs are seen to contain an abundance of caoutchouc, which can be drawn out into threads, as in the East African Landolphias.—*Electrician.*

The Human Footprints in Nevada.—The scientific world was much excited during the summer of 1881 by news of the discovery of human footprints near Carson, Nevada. The tracks were uncovered in quarrying stone for building. Some of the tracks were made by an animal allied to the elephant; some resembled the footprints of the horse and the deer; others were made by a wolf; and some were bird tracks. The supposed human footprints were in six series, each with alternate right and left tracks. The stride was about that of a man of medium height, being from 2½ to 3 feet in length. The footprints are from 18 to 20 inches long, and about 8 inches wide, and the line of the right tracks is separated from the line of the left tracks from 18 to 19 inches. This width of straddle was naturally regarded as affording strong reason for rejecting the belief that the footprints were those of men. Professor O. C. Marsh has put forward the much more probable theory that they are the tracks of a large sloth, remains of which have been found at the same level as the tracks. "The footprints," he says, "are almost exactly what these animals would make if the hind feet covered the impressions of the fore feet." In size, in stride, and in width of straddle the footprints agree closely with what would probably be made by the *Mylodon* or by the *Morotherium*, the two kinds of sloth whose remains have been discovered in the same geological strata.—*Newcastle Weekly Chronicle.*

THE COLOURED CURTAIN IN THE EYE.

By William Ackroyd.

THIS ring-like curtain in the eye, of grey, green, bluish-green, brown, and other colours, is one among the very many remarkable contrivances of the organic world. The eye cannot bear too much light entering into it, and the coloured curtain so regulates its own movements that too much light cannot enter the eye. The dark circular aperture in the centre, known as the pupil, is consequently for ever altering its size; on a bright sunshiny day, out in the open, it may be only the size of a pin's head, but at night, when there is no light stronger than starlight, it is even bigger than a pea.

This coloured ring curtain is fixed at its outer edge, and its inner edge expands or contracts so readily and, apparently, so easily, preserving its circular outline all the while, that it is quite provoking to the inventor, who has been trying to invent movable "stops" or "diaphragms" for years, and after all his labour cannot even approach it in perfection, and his despair is complete when he learns that the movements of this eye-curtain are automatic and quite independent of the will.

It is unlike the ordinary window-blind, which is generally of a rectangular shape, and is drawn up or let down according to the amount of light entering the room. The eye-curtain or iris is of ring shape, and possesses a wonderful power of expanding itself so as to diminish the area of the pupil, and of shrinking in, so as to enlarge the area of the pupil. Its movements may be watched in a variety of ways, some of which we shall describe.

The common way of watching the movements of the iris is to regard it closely in a looking-glass while the amount of light entering the eyes is varied. Place yourself before a looking-glass and with your face to the window. Probably the iris will be expanded, and there will only be a very small opening or pupil in the centre. Now shut one eye suddenly, while narrowly watching the other in the glass all the time. At the moment the light is cut off from one eye, the iris of the other contracts or is drawn up so as to enlarge the pupil. This shows that there is a remarkable interdependence between the curtains of the two eyes, as well as that they are affected by variations in the quantity of light falling on them.

Perhaps one of the most interesting ways of watching the movements of these sympathetic eye-curtains is one which may be followed while you are out walking on the street these dark winter nights. A gas-lamp seen at a distance is comparatively-speaking a point of light, with bars of light emanating from it in many directions. These bars, which give the peculiar spoked appearance to a star, are probably formed by optical defects of the lens within the eye, or by the tear-fluid on the exterior surface of the eye, or by a combination of all these causes. Be that as it may, the lengths of the spokes of light are limited by the inner margin of the eye curtain; if the curtain be drawn up, then the spokes are long; if the curtain be let down, or, in other words, if the pupil be very small and contracted, then one cannot see any spokes at all. Hence, as I look at a distant gas-light, with its radiating golden spokes, I am looking at something which will give me a sure indication of any movements of the eye-curtains. I strike a match and allow its light to fall into the eyes; the spokes of the distant gas-lamp have retreated into the point of flame as if by magic; as I take the burning match away from before my eyes, the spokes of the gas-lamp venture forth again. The experiment may be utilised to see how much light is required to move the window-curtains of the eyes. Suppose you are walking towards a couple of gas-lamps, A and B; B about fifty yards behind A. Then, if you steadfastly look at B and at the golden spokes apparently issuing from it, you may make these spokes a test of how soon the light of A will move your ires. As you gradually approach A, you come at last to a position where its light is strong enough to make the spokes of B begin to shorten; a little nearer still and they vanish altogether. I have found that about a third of the light which is competent to contract the pupil very markedly will serve to commence its movement.

Critical Points in Magnetism.—During the last meeting of the Physical Society Professor Hughes brought forward his magnetic experiments recently described by us, and one of the speakers remarked that soft iron brought to a red-hot state loses its property of being attracted by a magnet. As a matter of fact, Professor Hughes finds that this critical state is reached when iron is heated to a yellow-white, or just between white and red heat. Steel also loses its power of being magnetised when heated, and on being cooled to 100 deg. below zero, it again loses it. Nickel, again, loses its magnetic property at a comparatively low temperature—namely, that of boiling water, and Dr. Crookes has, we believe, devised a nickel cut out for electric lighting based on this curious fact.—*Engineering.*

In the six months from October 1st, 1880, to April 1st, 1881, 4,123 tires broke on sixty-five railroads in Germany, which had 21,247 miles of road—19·4 to every 100 miles of road, against 25 in 1880. The *Railroad Gazette* points out that there was one tire broken to every 124,760 miles run by a wheel. Like rails in this country, the breakages increase in cold weather. In successive months the numbers were:—October, 352; December, 435; January, 1,562; February, 775; March, 592. Below the freezing-point 1,553 breakages occurred; above it, 956.

Dynamite Struck by Lightning.—The following well-authenticated case of the firing of a dynamite magazine is of interest:—About a month ago, says the *Engineering and Mining Journal* of New York, the company operating the salt mines at Avery's, or Petit Anse, Iberia, Parish, La., received a large quantity of dynamite for blasting purposes. The same was stored in a magazine situated about four hundred yards from the works. Large trees were in close proximity. On Saturday, July 21st, a few minutes past twelve o'clock, a terrific storm burst on the island. Torrents of rain fell, and vivid flashes of lightning rent the skies. The workmen had barely left and reached the boarding-house, situated at some distance from the works, when the lightning struck the magazine, and immediately there followed an awful explosion. For a few minutes all seemed entirely paralysed. Recovering, some rushed out to ascertain the cause. It was then discovered that the whole building in which was stored the explosive compound had disappeared, and in its place was left a yawning chasm 15 or 20 ft. deep by about 100 ft. in length. The trees surrounding were prostrated and shattered. One, 2½ ft. in diameter was carried by the immense power in the blast, 200 yards from where it previously stood. Every building on the island contiguous to the mines was shaken in a terrible manner, causing every glass door and window to part with its glass. The buildings containing the mills and machinery were much damaged, preventing access to the shaft for the time being. Eight box-cars, ready to be loaded, were entirely crushed in their upper part, the running gear remaining intact.

THE HARVEST MOON.

By Richard A. Proctor.

FROM numbers of letters which have reached me within the last few weeks—to say nothing of past years—I infer that the explanations of the Harvest Moon in our books of astronomy have not proved altogether clear and convincing, or else perhaps they have not been very carefully read. In fact I have reason to believe that the moon's motions are not generally understood, or even known. I receive the most marvellous letters of inquiry respecting the moon's motions and phases,—some of them perfectly astounding in the calmness with which they demand explanations of peculiarities which have no existence in nature. One correspondent asks me why the moon is always full in the Arctic regions and never sets there, why she does not behave in the same way within the Antarctic as within the Arctic circle, and so forth. Another asks me whether there is any *other* explanation of the Harvest Moon than the effects of cold condensing the air; and so forth, till I feel disposed to lay down in despair the explanatory pen in order that I may take up that particular soft-nibbed quill with which I endeavour to impart information to those who chance not to possess it in any abnormal degree.

In my treatise on the Moon, the usual explanation of the harvest moon is given, with some details which are wanting from most accounts. Some errors also are corrected which have resulted from the careless way in which the comparatively rough statements of Ferguson have been copied and re-copied in our books on astronomy. I propose now to give an explanation which I believe to be new (at least in form). It also includes some information about the lunar movements usually overlooked.

First let it be noted that the path of the moon among the stars is somewhat like that of the sun, but inclined $5° 8'$ (on the average) to his.

Thus suppose Z N Z′ S represents the celestial sphere, S O N the horizon plane for London, N being the north point, S the south, the east and west points (Orient and Occident) being both at O (the former nearer the latter farther from the eye, which is supposed to view the celestial sphere from outside). Let Z be the zenith, Z′ the nadir, P O P′ the polar axis, E O E′ the celestial equator ($\angle$ P O N$=51\frac{1}{2}°$ and E O S$=38\frac{1}{2}°$).

Suppose the sun's path or the ecliptic represented by E O E′ inclined $23\frac{1}{2}°$ to E O E′. This path is of course carried round by the diurnal rotation, so that in our figure it might either be shown as a straight line or as an ellipse, according to the time of day and year. But once in each day the sun's path would have the position shown in the figure, the further half of the path passing through the west point at O and the nearer part through the east point at O.

Draw M O M′ *m* O *m′*, inclined $5° 8'$ to *e* O *e′*. Then M O M′ lines would represent the moon's path as projected into a straight line at the time when the inclination to the equator E O E′ is a maximum—or about $28°$; while

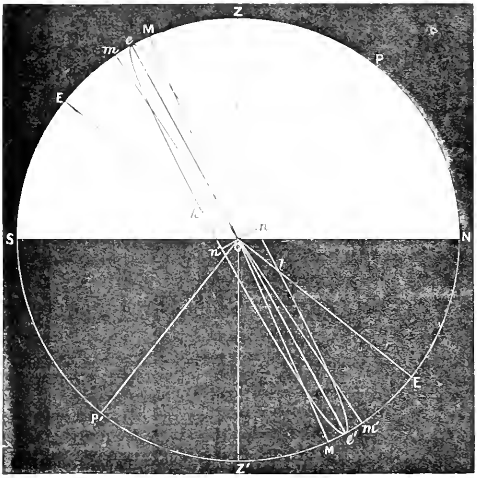


Fig. 1.

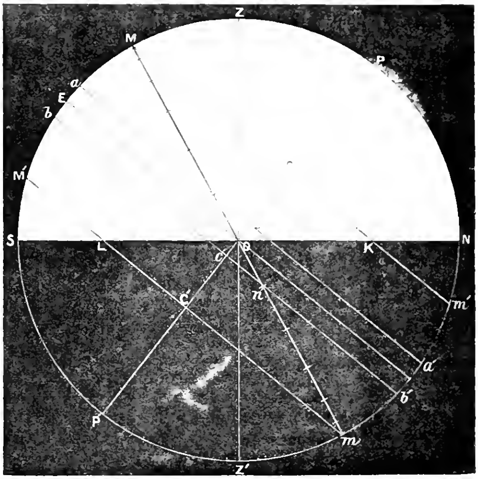


Fig. 2.

m O *m′* would represent the moon's path projected into a straight line at the time when the inclination to the equator is a minimum, or about $18\frac{1}{4}°$. The ellipse *e n′ e′ n* (*n n′*$=$M *m*) would represent the moon's path (sun's path being brought to position *e* O *e′*) at the time when the inclination has its mean value, about $23\frac{1}{2}°$, *k* and *l* being the points (*l* on the nearer, *k* on the farther hemisphere) where the path at this time cuts the equator.

About $18\frac{1}{2}$ years pass while the moon's path is changing from the position *m* O *m′*, to the position *e n′ e′ n*, thence to the position M O M′, and so through the position *e n′ e′ n* again, to the position *m* O *m′*.

We need not further amuse ourselves with these changes of inclination to the equator, but taking the mean inclination, as when the path is *e n′ e′ n*, consider the moon's monthly and diurnal motions,—and first without reference to changes of phase.

But it will be well to bring the celestial sphere to such a position that the path *e n′ e′ n* is projected into a straight line, manifestly in the position *e* O *e′* which before repre-

sented the ecliptic or sun's path, only it must be remembered that the moon's path round the celestial sphere never does coincide with the sun's path, but is always inclined about 5° 8′ thereto.

Let Z N Z′ S, Fig 2, represent the celestial sphere, other letters representing the same things as before, but M O m, inclined 23½° to the equator E O E′, representing the moon's path when at about its mean inclination to the equator.

Then in each sidereal month the moon (when at her mean inclination, and neglecting slight changes which her path is always undergoing) travels once round the path M O m, passing from O in the farther hemisphere to M, thence to O in the mean hemisphere, to m, and to O in the farther hemisphere as before. When she is at O, whether on the farther or mean hemisphere E O E′, the equator represents her diurnal course, O E O (from eastern O to western O) being the above-horizon half, O E′ O (from western O to eastern O) being the below-horizon half. She takes about 1 day 50½ min. in being carried once round, her own motion the other way causing the mean lunar day to be 50½ min. longer than the mean solar day. Of course the moon's motion in a day, solar or lunar, carries her considerably away from O, so that she never does actually complete such a circuit as we have just imagined. That is the circuit she would complete if she remained the whole day on the equator E O E′. As a matter of fact if she were at O at the beginning of a diurnal circuit she would have got to n or to n' at the end of that time, by her monthly motion along her own path M O m; at n if she were passing from O on the farther hemisphere ascendingly or northwards from the equator; at n', if she were passing descendingly or southwards from the equator point O on the nearer hemisphere. Her real course would be a spiral approaching P or P′ from E O E′: but we need not specially concern ourselves with this consideration.

When, a week after being at O (on the farther hemisphere, suppose), the moon has passed to M on her own path, her diurnal course is the circle M C m', of which only the small part represented by K m' (or projected into K m') lies below the horizon. A week later she is at O again: a week later at m; and now her diurnal circuit is projected into M′C′m, of which only the part represented by M′L (or projected into M′L) is above the horizon. A week later still she is again at O. Her real diurnal path is a spiral ranging between the parallel planes M C m' and M′C′m.

I have here said a week, when strictly I should have said a quarter of a sidereal lunar month, or of the time in which the moon completes the circuit of the stellar sphere. As a lunar sidereal month lasts 27⅓ days or thereabouts, each fourth of the circuit lasts about 6⅚ days, or not quite a week.

It is to be noticed moreover that when, as indicating with such problems as the harvest moon, we consider the successive risings, southings, and settings of the moon we are dealing really with the lunar day. Lunar days vary, indeed it is their variation which has chiefly to be considered in discussing the harvest moon: but of mean lunar days, there are only about 26½ in a sidereal lunar month, and about 28½ in a lunation. In fact in the lunar month the number of lunar days is one less than the number of solar days, the moon losing one diurnal circuit per lunation as compared with the sun.

We are now in a position, knowing what are the moon's movements without reference to phase, to determine what they will be in any given month when her phase at the time she is at any point of her own orbit, is known.

(*To be concluded in our next.*)

Obituary.

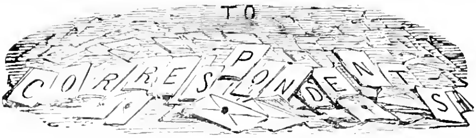
DEATH OF PROFESSOR TOBIN.

We learn with sorrow of the death of Professor Thomas W. Tobin, at Louisville, Ky. He will be well remembered by many in this country as a fellow-worker of Professor Pepper's at the Polytechnic; but obtained a wider and more enduring reputation in America as the inventor of the sine pendulum, and as a skilful exponent of scientific truths. He was born in January, 1844, in London, so that he was not quite forty years old when he died, on Saturday, August 4th last. He went to America twelve years ago with Professor Pepper, and resolved to stay in that country when Professor Pepper, disheartened by failure, returned to England. The Legislature of Kentucky made an appropriation of $500 for the construction of one of Tobin's sine pedulums, and Colonel Young was appointed as Commissioner to take charge of it when it was exhibited at Paris. The pendulum is now in the Agricultural and Mechanical College, Richmond, Ky. The Polytechnic Institution, Louisville, Ky., was founded chiefly through the exertions of Professor Tobin, Dr. Stuart Robinson, and Colonel Benuet H. Young. Professor Tobin was appointed scientific lecturer there, and held that position till the time of his death. Crowded audiences attested his skill in the art (more difficult than is generally thought) of so interpreting science as to interest the unscientific. Professor Tobin was a genial man, of companionable manners, wide-reading, and cultured tastes. He died of consumption, a disease to which his mother and all his brothers and sisters had already succumbed.

A Cable for Cochin-China.—The recent operations of the French in Tonquin have directed public attention to that part of the globe; but it is not generally known that the Eastern Extension Telegraph Company have for some time past made arrangements for laying a submarine cable between Tonquin and Cochin-China. It was intended to lay the cable from Saigon, where communication already exists, and Hai-Phong with a branch into Hanoi. Unfortunately, however, the French Chamber has rejected the proposals of the English company in favour of a less advantageous offer by M. Blanscube, deputy of Cochin-China. The Colonial Council of that possession have proposed to share the expense of constructing the new line, which there is every reason to believe will be made by French manufacturers and laid in French territory.—*Engineering.*

A meeting of the subscribers to the parliamentary fund of the Manchester Ship Canal was held on Tuesday week at Manchester. It was reported that the committee had received from subscribers £46,778, and that the expenditure amounted to £47,510. The committee were of opinion that another application to Parliament would be successful. A motion was passed expressing regret at the action of the Committee of the House of Lords in stopping the Bill. The provisional committee was empowered to promote the Bill in the ensuing session of Parliament, in such manner as might be found expedient or desirable. It was stated that promises of £5,000 had been received towards the cost of the second application to Parliament.

Letters from Athens, says a contemporary, announce an interesting discovery, brought to light in the course of some excavations which are being carried out in the Island of Delos by the pupils of the French School at Athens. In the neighbourhood of the Theatre of Apollo, they came upon the remains of a private house, which apparently belonged to the Alexandrine epoch. A court surrounded by pillars and twelve chambers has been opened out. The floor is composed of mosaic, which is a fine specimen, representing flowers, fishes, and other ornaments. In the middle of the court is a well, now quite choked up. The door of the house, and the line of roadway or street leading to it, have also been discovered. The excavations will be continued, and it is hoped that a large portion of the old town will be brought to light.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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[915]—With reference to the solution of the problem which appeared in your issue, No. 95, of the 24th inst., as to the height of Galley-Head Light, you have, it appears, assumed the distance to be twenty-one statute miles.

I think it probable that Prof. Tyndall meant twenty-one *nautical* miles, which would, allowing for the mean refractive effect of the atmosphere, make the height of the light about 205 feet.

The light is, as you say, known not to be as high as this, but most likely the data are not very correct. Hundredweight.

[I cannot see why Prof. Tyndall should be assumed to have meant geographical miles. Most probably he really estimated the distance from the known height of the light. The flat-earth men think any stick good enough to beat anyone with who talks of the sea's rotundity.—R. P.]

PUNCTUATION AND PRINTERS.

[916]—Sir Edmund Beckett's article on this subject is hardly likely to make converts either to his style or his mode of punctuation. Here is a phrase which I read several times before I could grasp either its sense or its grammar—"and when he sees that he ought to leave us alone to bear our own iniquities if we let our proofs go 'unpeppered' more than he thinks right." A comma after the word "that," which the punctual punctuator neglects to supply, would have made his meaning clear. Now, as to style, what about the following sentence?—"and thereby would raise the indignation of every architect in England into a still hotter flame *than it is in just now I see*, at my having dared," &c. And again:—"If anybody doubts your opinion of Macaulay's style, which was always mine [not the style, surely?], let him try it by the test of reading it [reading what? the opinion or the style?] aloud, against Froude's," &c. Sir E. Beckett's letter confirms me in my opinion that one can punctuate another man's work better than one's own. F. R.

["F. R." should remember that Sir E. Beckett's communication came as a letter, not as an article, and that he had no opportunity to correct the proof. The context showed the true meaning of the words "when he sees that"; no one could suppose that *that* that (that that that that that "F. R." says refers to) was meant for a conjunction. I have noticed in Sir Edmund Beckett's style that it usually takes for granted a certain degree of attention on the reader's part to the subject-matter. Granted this, no one can ever mistake his meaning,—though one may readily show that, where what he has said and what he is saying is not attended to, a sentence here or there may admit of more than one interpretation. Perhaps it is not unfair to assume that a reader pays a little attention to what he is reading. So much attention as would prevent any one from misinterpreting Sir E. Beckett is not a distraction—like attention called away by over-stopping, &c.—but tends the other way.—R. P.]

SMALL WHEELS *v.* LARGE WHEELS.

[917]—Mr. Browning's remarks advocating the use of small geared-up wheels for tricycles are sound, and will not be without their effect. But I have lately found out that (contrary to what he supposes) they may also be used for bicycles, with the additional result of making them so safe that they would certainly be brought into successful competition with tricycles on the question of safety.

I have recently invested in a bicycle with "Sun and Planet" action—a small machine, geared up in the most ingenious way, which cannot add anything appreciable to the friction. (It was at the Stanley show, but little display was made of it.) Though simple, it defies explanation without a diagram, and should be seen *in action* to understand it; but the chief point is that the very friction of the pedals on their axles is utilised to increase the speed, and has the effect of gearing-up the wheel from 40 in. to 50 in. The pedals hang down so that a tall man can ride it.

Now, if a yet smaller wheel (say 36 in.) were used, the rider's feet could touch the ground when he stopped, and it could be geared-up to 46 in. to 50 in. With such a bicycle there could be no real danger, the advantages of handiness, lightness, and speed would be retained, and no doubt many would ride who would not think of doing so now. S. J.

REDUCING FAT.

[918]—What is the use of you devoting so much of your valuable space to the service of fat people. I am quite sure there are not *two* "gross fat men" among your many thousands of readers.

I can prove it, and that easily. Fat men are mostly stupid. Stupid men don't read Knowledge, therefore none of your subscribers are fat, and if you have *no fat subscribers* what is the use of your otherwise useful contributor wasting his energies in this hot weather by seeking to reduce adipose tissue that does not exist. He surely does not aim at reducing fatness in the abstract. I think it has been decided that it is impossible to imagine a fat man in the abstract, and I should like to know how you can administer a towelling to such an individual.

But what has most annoyed me is your contributor's last article with its remarks on this said towelling. I am as thin as a rake, and for many years I have taken sponge and towel exercise such as he describes, in the belief that it tended to increase of flesh. Now, your contributor comes along and tells me in effect that I have been rubbing it off. Must I, if I wish to accumulate flesh and make the acute angles of my anatomy more circular, to put it scientifically, leave off rubbing and scrubbing? W. S.

[The author of "How to Get Strong" was moved to write those particular papers by the appeal of several "heavy weights." He tells me (is it not impolite?) that he had "Our Editor" also in his eye. But many of the rules for reducing fat are excellent also, he tells me, for adding flesh. Therefore your towelling is probably good for you as well as for us fat fellows.—R. P.]

DIFFERENT DEGREES OF ILLUMINATION.

[919]—Some remarks towards the close of the article on the "Laws of Brightness," in last week's issue of Knowledge, induce me to offer you an artist's experience and reflections upon the subject. One of the undertakings I have ventured upon is that of substituting a science of art for the jargon which passes current. In the course of my studies to this end, the fact that the colour and the chiaroscuro of a picture never have precisely the same values the artist intended, in any but the light in which the work was executed, set me thinking, and this was the form of my conclusion, that *the ratios of the different reflecting powers of objects vary under different degrees of illumination*; and the following was the mode in which I attempted to illustrate the change effected. Take any series of numbers, for instance, 2, 4, 8, 16, then, either the addition to, or the subtraction of the same number from each term of the series, yields two other series in which the ratios of the several terms to each other are entirely altered. W. Cave Thomas.

COLOURS OF FLOWERS.

[920]—Mr. Slack, in his "Pleasant Hours with the Microscope," has given us in Knowledge a short but interesting account of the hairs of plants; how they perform the function of feeders or digestive organs by absorbing ammonia and carbon from the air. Plants also, I suppose, absorb silex and other primordial atoms from the soil. Can Knowledge, with the aid of botany, chemistry, and microscopy combined, assist us to understand how *colour* is formed in *flowers*. Colouring matter *from* plants is a well-known province of chemistry, but how are the varied colours which delight the eye and decorate the garden given *to* flowers? Is this capable of analysis or ratiocination? Lucretius (Book ii.) thought all elementary atoms colourless; Pliny (Book xxi.) that Nature, in sport, had bestowed the tints which man could not describe. Is this one of the mysteries wherein Nature laughs at the inquisitiveness of man?—Your obedient, G. G. Hardingham.

SUNSET ON THE MOON.

[921]—Watching the moon to-night, I was trying to imagine what sort of event sunset would be if one could get over the little difficulty of reaching our satellite, and be independent of such slight details as respiration, extremes of heat and cold, &c. I was getting along splendidly with the intensely black sky, the myriads of stars shining day and night, the enormous disc of the earth constantly in almost one direction, part of it bright with reflected sunlight, part just relieved from darkness by a faint reflection of moonshine, and the shading from light to dark by the refraction of our atmosphere. I supposed the sun's disc to have reached the horizon, and (roughly) in about an hour of terrestrial time his last fierce ray suddenly to fade, leaving not a suggestion of twilight to show he had been there. But here I was stopped. *Would* he disappear in this way? Of course not. Every solar appendage that can be seen from the earth during a total eclipse would be always visible from the moon. Consequently, when the disc (such as we see it from the earth) had passed below the horizon, there would still remain a gorgeous sight for our adventurous traveller [please do not call him a lunatic].

Now, this is my point. Between the part of the moon which is in darkness and the part which is fully illuminated there must be a strip which is still receiving light from the parts of the sun that lie beyond the disc visible to us. Is it possible to separate and examine the light reflected to us by that strip of the moon's surface, and so to add to our knowledge of its source? Probably the idea is already familiar to you, and its feasibility may have already been tested. Be this as it may, if I have furnished you with a text for some future article in KNOWLEDGE, I know I shall receive a hearty, though silent, vote of thanks from its readers. [I likewise bows.—R. P.] W.

FIGURE-CONJURING.

[922]—Referring to recent communications which have appeared in KNOWLEDGE, under the head of "Figure-Conjuring," I should now like to give an experiment, abridged from Professor Hoffmann's book on "Modern Magic," which I think will give completeness to the experiments above alluded to.

The performer asks one of the company to take two dice and shake them secretly in his hands; he must then turn them down on the table, shading them with his arm from all eyes but his own, and must then write down privately on a piece of paper, the numbers turned up, placing the same apart from each other. The performer then tells him to multiply the left-hand number by 2, then add 5, then multiply by 5, and then add the right-hand figure. He then tells the performer the total thus obtained, and the performer after mentally deducting 25 from the same, announces what two numbers were turned up by the dice. Thus, supposing one die showed 4 and the other 5, then the experiment would proceed thus:—

```
                         4————5————
                       × 2
                         —
                         8
                       + 5
                         —
                        13
                       × 5
                         —
                        65
Add right-hand figure    5
                         —
                        70
Deduction mentally by performer 25
                         —
                Leaving 45, the figures turned up.
```

Now, if the figure-conjuror would show off this experiment in the first place, then follow it up by the one given by myself (858), and, in case of difficulty with some extra-sharp victim, cap the list by going through the one given by Mr. Proctor on page 26, I think he would then astonish his audience as much as if he had gone through a clever performance with the cups and balls. I cannot close this communication without thanking our indefatigable editor for the article above referred to; I consider it quite a valuable addition to the literature of the subject. To descend from the stars to the constructing of an article on Figure-Conjuring may appear to some persons a somewhat incongruous proceeding. I, however, am quite of a contrary opinion to this. To the truly great and fully-developed mind nothing is too great and nothing too small. The wonders revealed by the microscope are quite as astonishing and mysterious as those revealed by the astronomer's tube. In truth, to the scientific eye, "great" and "small" are synonymous. G. M.

GREATEST CONTENT OF A PARCEL WHICH CAN BE SENT BY POST.

[923]—The problem on this subject, which you have solved on p. 76 by the Differential Calculus, can be solved without it, as follows:—

First.—Suppose the parcel to be a parallelopiped. Since the sum of the length and girth is 6 ft., the sum of half the length, the breadth, and the thickness, or the three dimensions of half the parcel is 3 ft. It is plain that the bulk of half the parcel will be greatest when these dimensions are equal, each 1 ft. Therefore the content of the whole parcel is greatest when it is 2 by 1 by 1 = 2 ft.

Second.—Suppose the parcel to be a cylinder. As the bulk of a cylinder has a constant ratio (that of 4 to π) to the bulk of a parallelopiped of the same length and girth, the maximum cylindrical parcel must have the same length and girth as the maximum parallelopiped, that is, its length must be 2 ft., its girth 4 ft., its bulk $\frac{8}{\pi}$ ft. ALGERNON BRAY.

[The problem was given as an illustration of the application of the differential calculus to simple questions.—R. P.]

LETTERS RECEIVED, AND SHORT ANSWERS.

JAS. M. RODGER. A "flat upon a circle" may, for aught I know, be $\frac{1}{60}$th of the circle itself. I do not happen to know what a flat on a circle is.—ALG. BRAY. Latest letter on flight of missile correct, but no space for so long an investigation. Thanks for other letters.—THOS. SAYER. Will shortly put the list of Nos. in which articles on "How to Get Strong" have appeared at head of one of the forthcoming articles.—HARVEST MOON. There *are* "other causes than cold condensing moisture in the atmosphere to produce what is known to us as the harvest moon."—E. C. H. Thanks. Highest tide about three tides after full moon.—B. J. JENKINS. Thanks for correction. Reasoning in other letter scarcely convincing.—JAS. CRAM. Squares causing so much anxiety that I shudder at the thought of magic cubes.—W. S. Why should that meteor not belong to our system? Meteors often behave so.—FRANCIS H. Have as yet had no opportunities to examine the system.—G. G. H. Fear no space for numismatics, though the subject is, no doubt, interesting.—A. M. COBBOLD. The subject of spelling reform—and especially of ways in which practical attempts might be made to introduce it—is too wide for these columns.—H. H. Map of the Moon accompanied first of "F.R.A.S.'s" interesting papers. I have not vol. iii. by me for reference; know the map is in that vol.—J. S. The angle cannot be trisected by simple geometry; for the equations corresponding to the geometrical requirements is a cube. I am obliged to you for your kind expression of sympathy, though your "pleasure on hearing of my gradual recovery" might be misinterpreted.—W. WILSON. You are right in thinking that the Southern Cross affords a perfect proof of the earth's rotundity. Yet not quite as you present it; for you write as if the Southern Cross were a Polar constellation; and you overlook the difference in rotation-time at which, in the opposite directions indicated by you, the Cross is visible. An earth-flattener of the foolish sort would find a ready answer to the argument derived from mere difference of direction in the journeys taken towards the ice-barrier. But you mistake in supposing the Pretty Proofs part of a discussion with the earth-flatteners. They are so few that such a discussion would be waste time. Proofs of the earth's rotundity are interesting to those who know perfectly well that the earth is round. The existence of a Southern Celestial Pole round which as uniformly as round the Northern pole the stars revolve in parallel circles, is an absolute proof of the absurdity of the flat earth theory for all who have brains; but it is not sufficient for the flat earth men.—G. JORDAN. The Lunar Theory about which the Astronomical Society was talking is not what you mean by the Lunar Theory. The subject of the lunar acceleration is in no way connected with the elementary phenomena of the moon's movements. You are in deeper water than you think. I do not associate you with Hampden & Co. As to them I mention their ignorance and folly, only because of their violence and rudeness.—A WOULD-BE OBSERVER. Cannot do that.—M. H. B. Knowing nothing can say no more.—F. LETHRINGTON. Question outside our scope.—NIGEL DOBLE. Such a telescope would be almost worthless.—R. JONES. The answer relating to Text-book matter did not relate to the trisection of an angle. Cannot remember answering any question recently on this subject. Possibly some answer to another correspondent has misled you. I remember only that the question related to text-book matters, which would have occupied many pages of explanation

[Have just found your trisection question among unanswered and unopened correspondence. The trisection is perfectly sound, and if the secant could be drawn, by line and circle, to fulfil the conditions named, any angle could be trisected by line and circle. Unfortunately it cannot.—E. H. M. S. Would be glad to hear of a good book on the chemical constituents of garden vegetables.—Lutetia Rediviva. An odd coincidence. But the history of the discovery of Uranus is well-known. Sir W. Herschel himself fully recorded it, and there is nothing in the slightest degree confirming Paris's statement.—E. S. Thanks; the idea is a good one. A series of pictures of the old constellation figures, with stars, names, and explanations of these, would probably interest many. Will try to arrange the matter.—A. Holdsworth. A telescope will not reveal the hull under those conditions.—Information. Pitman's I should say. Other questions belong to a kind we have been obliged to leave unanswered.—H. J. W. Mars has two satellites, both very small,—probably not more than fifteen miles in diameter. There is an essay on them in my "Poetry of Astronomy," entitled "Living in Dread and Terror," these being the Englished names of the two satellites of Mars (Demos and Phobos).—F. R. The "cold spells" are purposely omitted by smoothing off the temperature curves.—An Inquirer. The institution of Infant Baptism is a little outside our line.—T. H. K. The weight lifted is not great,—each raised less than 3 stone, each forefinger raised less than 1½ stone. The inspiration, expiration, &c., only help I imagine by directing attention to the proper amount of lifting: so that all act together. But really lifting 40 lb. with the two forefingers is hardly a feat requiring special preparation or special explanation when accomplished.—E. T. L. Solution correct.

MATHEMATICS.

Prop.—A B, D C *are equal chords to the circle* A B C D, *meeting in* F; *and tangents* F P, F Q *are drawn, and* F *b* O *a through the centre* O. *Show that chords* B D, A C *intersect at* P Q.

It is clear from symmetry that G, their point of intersection, lies in *a* F; and it will suffice to show that a perpendicular chord P G Q cuts the circle in the points P, Q, where tangents from F meet it. Join O B; then in the triangles O G B, D G F, angle O G B = opp. angle D G F; and ∠ G O B (being angle at centre on B *b*) = angle at circumference at B C = angle B D F. Hence, the triangles are similar, and

$$OG : GB :: GD : GF$$
$$\therefore OG, GF = GB, GD = \text{sq. on } PG$$

Wherefore, O P G is a right angle, and F P, F Q are tangents. Q.E.D.

Cor.—*If* F *be an external point from which tangents* F P, F Q *are drawn to a circle, and* P Q *cut* F O *at* G, *then straight lines* F B, F D *to the extremities of any chord* B D G *through* G *are equally inclined to* F O.

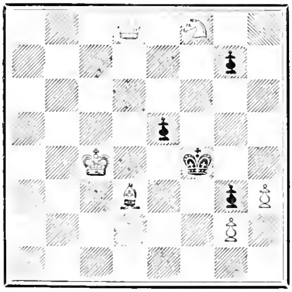
Our Chess Column.

By Mephisto

PROBLEM No. 96.

By J. Berger Graz.

Black.



White.

White to play and mate in three moves.

FRENCH DEFENCE.

White. Herr Berger.	Black. Herr Boduschka.	White. Herr Berger.	Black. Herr Boduschka.
1. P to K4	P to K3	14. Q takes B	R to B sq
2. P to Q4	P to Q4	15. QR to Q sq	P to B3
3. QKt to B3	KKt to B3	16. R to Q3	Kt to Kt3
4. B to Q3	P takes P (*a*)	17. P to KR4	Kt to K2
5. Kt takes P	B to K2	18. P to R5	K to R sq (*c*)
6. KKt to B3	Castles	19. P to R6	Kt to B4
7. Castles	QKt to Q2	20. P to Kt4	Kt takes RP
8. R to K sq	R to K sq	21. P to Kt5	B takes P
9. QB to KB4	Kt to B sq (*b*)	22. Kt takes B	P to KB4 (*d*)
10. B to K5	P to QKt3	23. Q to R4	K to Kt sq
11. Q to K2	B to Kt2	24. R to Kt3	R to K2
12. Kt tks Kt (ch)	B takes Kt	25. Q takes Kt	P takes Q
13. B to K4	QB takes B	26. Kt tks KP (ch)	Resigns (*e*)

NOTES BY HERR BERGER.

(*a*) P to B4 is the right move here.

(*b*) If Kt to R4 then follows 10. B to K5 in reply. If then Black plays P to KB3, White could answer with KKt to Kt5!

(*c*) This is a lost move, and strengthens White's attack.

(*d*) If Q takes Kt, White will either win a piece or the Q by R to Kt3.

(*e*) After the exchange of pieces White will remain with a R ahead, *i.e.*, K to B2. 27. Kt takes Q (ch), R takes Kt. 28. R to Kt7 (ch), K to B sq. 29. R takes R, K takes R. 30. B to B7 (ch), and wins.

SOLUTION.

Problem No. 93, by L. P. Rees, p. 128—1. Kt to B3, and mates accordingly.

ANSWERS TO CORRESPONDENTS.

_ *Please address Chess Editor.*

Berrow.—If in Problem No. 90, 1. Kt to Kt7, P takes Kt, then 2. R takes P (ch), K to K3, 3. Kt to Q8 mate.

H. Seward.—There is no penalty if a player announces mate and fails to give it.

Correct solutions received:—Problem 93, Hammond, John Watkins; Problem No. 95, Clarence, M. T. Hooton, H. Seward, Berrow, L. F. Q., End-game, Clarence.

Contents of No. 96.

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Contents of No. 98.

A NATURALIST'S YEAR.

By Grant Allen.

XXI.—THE BARN OWL FLIES.

As the shades of evening begin to fall, the big barn owl, from the top of the old broken sham-castle on the hill-side, crawls out regularly every night from the over-sheltering ivy, and sets forth stealthily upon his predatory expedition in search of stray wandering rabbits, rats, and mice. A weird and uncanny thing he is to be sure, worthy to be held in superstitious awe as a bird of ill-omen; and yet, I suppose, he merely flies by night from necessity, not from choice, because the creatures on which he has adapted himself to prey come out by night for their own feeding-time. Your common barn owl, in fact, is one of the remoter hangers on of civilisation, an outcast who follows close on the heel of the agricultural pioneer all the world over, till at last it has become almost impossible to say in what countries he is really indigenous, and in what he is merely a perfectly naturalised alien. The reason for this is simple and obvious enough. Wherever man sows and plants, the rat and the mouse, in one or other of their local forms, thrive and multiply most exceedingly. Not only in houses, but even more in cornfields, barns, farmyards, and granaries, these unwelcome guests of civilisation flourish everywhere in the greatest abundance. Now, the barn owl was from the very beginning, apparently, the member of his own race most peculiarly adapted to prey remorselessly upon these small and comparatively defenceless quadrupeds. So, as the mice, rats, and shrews increased in numbers with the increasing supply of food afforded them by the grain or the insects of cultivated fields, in like manner did the predaceous barn owls increase side by side with them to prey upon them, as their natural food. All the owls, in common with other birds of prey, have a convenient habit of rejecting the bones of their victims from the stomach, undigested, in little pellets, which saves their alimentary canal a lot of useless labour; and the examination of these pellets, in the case of our friend the barn owl, sufficiently dispels the wicked calumny of gamekeepers that he feeds mainly upon young birds, as the bones of which they are composed are almost entirely those of small mice, voles, shrews, and other petty rodents or insectivores.

Though it is not quite formally correct to describe the owls, after the good old fashion, as the nocturnal birds of prey (for some of them hawk about in the broad daylight, while at least one of the falcon tribe, or so-called diurnals, has, *per contra*, acquired the habit of hunting bats by night), there can yet be no doubt that the owls as a group have really gained most of their distinguishing characteristics in adaptation to a night-flying existence. Their very shape and structure marks them out at once as widely different in habit from the frank and bold birds of prey, like the eagles, hawks, and falcons, which mostly pursue their quarry in the open sky. Their oddly-shaped legs fit them for squatting in the peculiar, sleepy, owlish attitude; their short necks and clumsy bodies are better fitted for prowling in the dusk after ground animals and game birds, than for pursuing swiftly-flying creatures like those which form the main food of the rapid hawks and falcons. But the big head, with its ruff-like disc, which is perhaps the most marked feature in our common English owl, bears still more distinct reference to the specially nocturnal habits of the entire race. Owls, apparently, are more highly developed hawks, specialised in many respects for night-flying habits; and therefore their sense-organs have had to undergo the usual modifications in adaptation to their peculiar environment. As in most lemurs and other advanced nocturnal mammals, the eyes are very large and noticeable, and are surrounded by a sort of reflector of curiously-arranged concentric feathers. They are admirably adapted for vision in the dusk or with a minimum of light; but, at the same time, the peculiar organs in the retina which are supposed to be employed in the perception of colour are entirely absent. It is a noteworthy fact in this connection, that owls themselves seldom show any traces of colour in their own plumage, other than various shades of black, white, grey, and brown. Their hues are generally protective, and enable them to pass unnoticed in the daytime upon the bark of trees. This is, indeed, what one might naturally expect, because Mr. Darwin has shown that ornamental colouration in birds is due almost entirely to the sexual selection of the most beautiful mates; and a group like the owls, which are actually destitute of the nervous apparatus for perceiving red, blue, green, and yellow, cannot well show a marked preference for such gaudy hues in their own fellows. As a matter of fact, the few decorative adjuncts to be found amongst them are entirely confined to pure white plumage, as in the snowy owl (a day-flyer), or to tufts and rings of feathers in the most conspicuous and visible positions, as in the long-eared owl of our own islands. In this respect, owls form a complete contrast to such brilliant fruit-eating groups as the parrots or the toucans; yet it is interesting to observe that one very aberrant New Zealand parrot, which is also nocturnal in its habits, and closely resembles the owls in appearance, down even to the possession of the distinctive disc around the eyes, has toned down the prevailing green of its ancestral colouration into a very owl-like shade of dingy olive-brown, speckled with tawny yellow. This is one of the numerous cases which show us that similarity in mode of life will produce strong adaptive external resemblances between very diverse creatures originally descended from extremely unlike ancestral lines.

Nocturnal animals require largely to supplement sight by hearing, a fact which is well illustrated in the enormous external ears and peculiar appendages of many advanced forms of bats. In the owls, evidence of similar adaptation

is not wanting. The external ear-opening is extremely complicated, and its peculiarities are different in different genera of owls. One kind even has the ear-opening on the right side of a different shape from that on the left. Everybody who has ever watched our English barn owl closely, knows well that its sense of hearing is most keen and acute. It is, doubtless, this large development of the exterior sense-organs that makes the heads of most owls so disproportionately big. There is one peculiarity of the whole owl group, however, which they share with a single other bird of prey—the osprey—and which does not seem immediately connected in any way with their nocturnal habits, though it fits in admirably with their usual skulking mode of life, and that is, the power which they possess of reversing their outer toe, so as to turn it outwards or inwards at will. A peculiarity like this must probably descend to them from a common ancestor, who perhaps was not yet nocturnal in his mode of life. As a consequence, owls can sit with two toes on one side of the perch and two on the other, a thing impossible for hawks and eagles, whose toes are arranged to go three on one side and one on the other.

Our own common barn-owl is a good representative of the usual habits prevalent among the race at large; but, like most other successful groups, the owls have split up into a good many genera and species, several of which have diverged considerably in structure, and still more in habits, from the central type. While most of them hunt rats and mice, and such small deer, the great eagle-owl of Germany and Switzerland eats not only rabbits, hares, capercailzie, and pheasants, but even so large an animal as the fawn of the roebuck. Other owls, again, have taken to fishing, like their distant relative, the osprey; and, like him, they have lost the feathers on the lower part of the leg, and acquired a series of small spikes on the sole of the toes, to aid them in holding their slippery prey. One of these is common in India, and three rarer kinds frequent the streams and inland lakes of Africa. A few owls have even reverted once more to the habit of hunting their food by day, like the snowy owl, which is perhaps the handsomest member of the entire race. Some of the tiny continental species have greatly degenerated in size, till they have grown no bigger than an ordinary robin. Such decrease of size, though it looks at first sight like a disadvantage, may really help a species in the struggle for existence by enabling it to procure smaller but more abundant food. The wee pigmy-owlet of the Mediterranean region could easily pick up a livelihood for himself in many districts where the great eagle-owl, adapted to broad, forest-clad plains, would starve hopelessly.

Herbert Spencer.—"The work which Herbert Spencer has done in organizing the different departments of human knowledge, so as to present the widest generalizations of all the sciences in a new and wonderful light, as flowing out of still deeper and wider truths concerning the universe as a whole; the great number of profound generalizations which he has established incidentally to the pursuit of this main object: the endless rich and suggestive thoughts which he has thrown out in such profusion by the wayside along the course of this great philosophical enterprise,—all this work is so manifest that none can fail to recognise it. It is work of the calibre of that which Aristotle and Newton did, though, coming in this latter age, it as far surpasses their work in its vastness of performance as the railway surpasses the sedan-chair, or as the telegraph surpasses the carrier-pigeon."—John Fiske.

PLEASANT HOURS WITH THE MICROSCOPE.

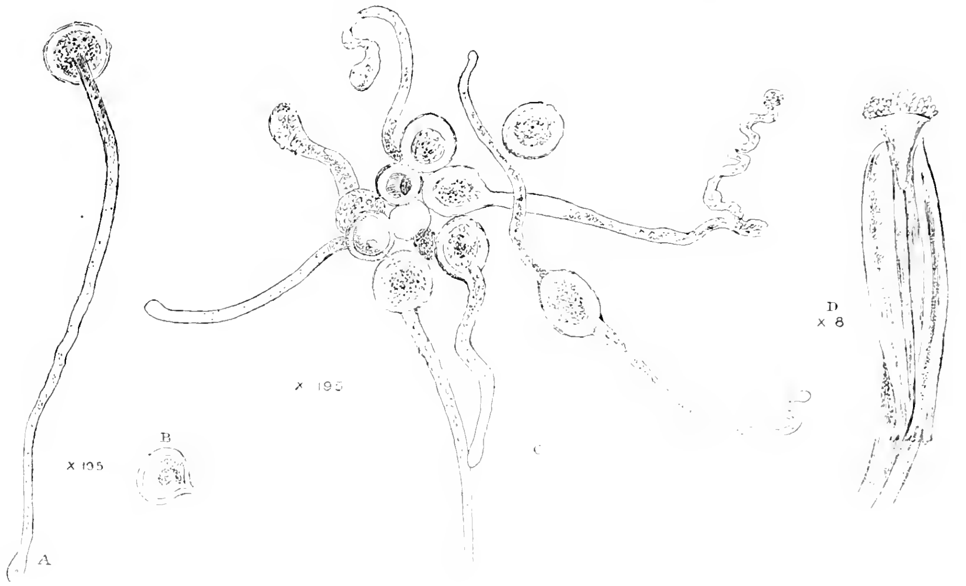
By Henry J. Slack, F.C.S., F.R.M.S.

Everybody knows that in the middle of an ordinary flower, say a geranium or a lily, there rises a column, usually slender, with a peculiar formation at the top. In the scarlet geranium this is five-fingered, in the lilies more knobby and with three divisions. The column is the style and the organ at the top the stigma. The two constitute the pistil. In a perfect flower the observer will notice a series of whorls, forming the calyx, the corolla, a group of filaments bearing anthers and surrounding the pistil, and, lastly, the pistil itself, more or less elongated, but in all cases rising from the simple or compound ovary. It is very interesting to notice the shape of these parts in various flowers. There is great variety in the anthers and in the stigmas, but the function of the former is always to produce the pollen or male element, and the stigma is adapted to receive it, and cause it to convey some of its contents to the ovules in the ovary.

Pollen is of various sizes and shapes—frequently round and frequently oval, or shuttle-shaped. In the melon it is round and spiked like a horse-chestnut, and provided with circular lids at certain spots. The passion-flower (*P. cœrulea*) has round pollen, covered with a network pattern, and provided with large lids. The musk plant, chicory, mallow, and many others exhibit interesting varieties of shape, and the "Micrographic Dictionary," pl. 32, gives a figure of the pollen of *Basella alba* like a square box, with the appearance of a round hole in the middle of each side. Many sorts of pollen look under the microscope as if they had holes in them, or slits, but these appearances probably in all cases arise from those parts being thinner or more transparent than the rest. When the pollen sprouts it is from these spots, and in those which have lids the outgrowth forces them open.

The stigma is provided with several means of holding the pollen conveyed to it. It is roughened with glandular papillæ in the scarlet geranium, and in many plants when it is ready for the pollen it pours out a glutinous secretion. It would lead us away from our present object to describe the various contrivances by which plants avoid self-fertilisation, and the different ways, by insect help and otherwise, through which they receive pollen from other individuals. Let us suppose a pollen cell deposited upon a stigma. It finds itself stimulated to put forth a slender outgrowth, which has to work its way down the style and reach the ovule it is intended to fertilise. Some plants (gourds for example) enable this process to be traced, but only skilled observers and dissectors are likely to see much.

Plants of the lily family offer the easiest means of seeing the growth of pollen tubes. A little pollen should be placed on a glass slide in a drop of the fluid secreted by the stigma, lightly covered with thin glass, and steadily watched. *Lilium excelsum*—the pretty, sweet-scented, buff lily—and *L. Auratum* are recommended. The sketches given with this paper represent what occurred with the pollen of a very beautiful plant now frequently found in conservatories, and belonging to the Ginger family. It is called *Hedychium Gardnerianum*. A fine specimen in full flower is a splendid sight. The one in question exhibited a broad head of flowers nearly a foot high. Each corolla consists of six segments in two rows, the sixth being the biggest, with a notched lip. The arrangement of the anther and style is shown in Fig. D. The two lobes of the anther clasp the style and lower part of the stigma, which rises above them. The filament bearing the anther is



grooved, and the style runs up it. When a corolla is fading, a gentle pull will draw out the style, and it is found to be very slender. The filaments are deep orange red, the petals bright pale yellow. This makes an elegant contrast, and the plant exhales a delicious scent of a honey-and-ginger character. To see it to perfection it should be placed in a sitting-room window, or cool corner of a conservatory, as soon as any of the flowers begin to open. With such treatment it will display its beauty for several days, while in a hot place the corollas that first open fade before the others are ready, and a shabby appearance is produced. A honey fluid drops freely from the stigmas, and is very viscid. Taking some of the pollen and putting it in this fluid slightly diluted with water, generally succeeded on a bright day in inducing some of the pollen cells to sprout. At first a little projection was found, as at B. This was quite clear and glassy. It gradually elongated into a tube, a clear space being always in advance, which showed the vital action to be in the tube walls. They were not pushed forward by the granular matter, but that waited for their growth, and then entered into the space provided for it. A represents one of the best developed tubes formed in the course of a few hours; C, a group of pollen cells and tubes, one cell emitting a tube on opposite sides. Very often, instead of forming a regular-shaped tube, the pollen cell allowed the granular matter to escape in the forms shown by two cells, one on the right and the other on the left in the figure. That on the left was a mess from the beginning—that on the right began well and ended in a zigzag muddle. A represents the nearest approach to the right thing, but probably the tube is more slender when it grows out of the cell under natural conditions.

Botanists distinguish the outer coating of the cell as *extine*, and the inner layer as *intine*. The intine forms the tube, and the granular matter undergoes a development which fits it for the work of fertilisation. The time it takes for a pollen tube to develop varies with different plants. Ultimately it gets into an ovule through a small entrance (micropyle), and proceeds to its special work more quickly or slowly, according to the nature of the plant. Sachs observes:—"The time that intervenes between pollination and the entrance of the pollen tube into the micropyle depends not only on the length of the style, which is often very considerable (as in zea and crocus), but also on the specific characters of the plants. Thus, according to Hoffmeister, while the pollen tubes of *crocus vernus* only requires from twenty-four to seventy-two hours to penetrate the style, which is from five to ten centimètres in length,* those of *Arum maculatum* take at least five days, although the distance they have to go over is scarcely more than 2 or 3 mm.†, and those of *Orchideæ* require ten days. or even several weeks or months, during which time the ovules first become developed in the ovary, or even are not formed till then." When the pollen tube has reached its destination, the development it induces may be quick, or, as is the case with many trees, may take weeks, or months. In the meadow saffron (*Colchicum autumnale*) Hoffmeister finds the pollen tubes enter at the latest at the beginning of November, but it is not till the May following that the formation of the embryo begins.

The experimenter with pollen grains must not expect uniform success. Operating with those of the Hedychium several failures were encountered, and on a dull day without any instance of success. If the pollen cell shows no inclination to make the little bulge that is the commencement of a tube in an hour or so, it is well to begin again with a fresh lot. The pollen grains should not be too thickly crowded, and the viscid fluid only thinned just enough to flow freely amongst them. In some plants the fluid of the stigma may not require this, and it is as well to try it in the state in which it is exuded.

* 10 centimètres = 3·937 inches.
† A millimètre = [illegible] of an inch; 26 are rather [illegible]

THE HARVEST MOON.

By Richard A. Proctor.

(Concluded from page 157.)

ONCE in each sidereal month the moon completes the circuit of her orbit, shown in its mean position in Fig. 2, the lunar day varying in length as the sidereal month proceeds as the solar day varies each year, only in greater degree because a lunar day is a larger proportion of a lunar sidereal month than a solar day is of a year. For, there are only about $26\frac{1}{3}$ lunar days in a sidereal month, as compared with $365\frac{1}{4}$ solar days in a sidereal year.

Suppose the moon at O on the half of the path M O *m* remotest from the eye outside the disc. Then at the end of a lunar day she is at *n*. Whereas then her path above the horizon would have been represented by E O E′ had she remained at O on her path among the stars, her path above the horizon would now be represented by *a n a*′, if she stayed for a lunar day at the point *n*. Her point of rising will be at *k*, nearly enough for such an inquiry as the present, in which we may suppose E O E′ her diurnal path in one day, and *a n a*′ her diurnal path on the next day. She rises then at the point *k* on the nearer half of the sphere S Z N Z′, is carried to *a* her highest point above the horizon, and passes down to the western horizon at *k* again; then below the horizon to *a*′ and so back to *k* again,—though in reality by this time she has reached (in her path round the stellar heavens) the mark on O M next beyond *n*.

Manifestly then the moon rises sooner and sets later in traversing the diurnal path *a* O *a*′ than in traversing the diurnal path E O E′ The straight line *k c*, is in reality the foreshortening of the arc by which the time of rising precedes what it would be if the middle point *c* (on the nearer hemisphere) of her half circuit *a c a*′ were her rising point: *k c* is also the foreshortening of the arc by which her time of setting follows what it would be if *c* on the farther hemisphere were her setting point.* Thus suppose the circle *a c a*′ of Fig. 2 (foreshortened there) opened out as in Fig. 3, the nearer half taking the position *a d a*′ while the farther half takes the position *a d*′ *a*′. Then *f d a f*′ represents the arc above the horizon, while *f*′ *a f* represents the arc below the horizon. The equal arcs *d f* and *d*′ *f*′ indicate the amount by which the time of rising precedes and the time of setting follows the mid times between *a*′ and *a* and between *a* and *a*′. This arc will be found, if the projection is carefully made according to the known position of the orbit M O *m* Fig. 2, and the moon's motion therein, to correspond to about half an hour's diurnal motion when M O *m* has its mean position as in Fig. 2, to about twenty minutes diurnal motion when the moon's orbit has its least inclination (*m* O *m*′ Fig. 1, p. 156,) and to about forty minutes diurnal motion when the moon's orbit has its greatest inclination (M O M′, Fig. 1). Thus the day after passing the point O of her orbit, the moon rises half an hour or so (on the average) earlier than she would if she remained all the time on the equator. In this last-named case of course she would rise day after day $50\frac{1}{2}$ minutes later, a mean lunar day being 1 mean solar day and $50\frac{1}{2}$ minutes. But when at this particular part of her path around the star sphere, she rises not $50\frac{1}{2}$ minutes later on successive nights, but only about $20\frac{1}{2}$ minutes later because her movement northwards from the equator makes her rise about 30 minutes earlier than she otherwise would.†

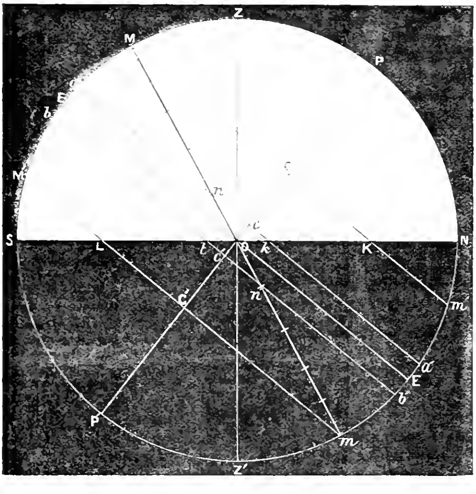


Fig. 2 *bis*.

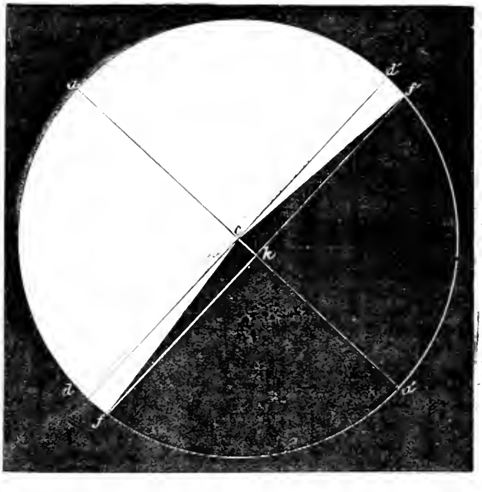


Fig. 3.

* I take this opportunity to correct what I find to be a prevalent error,—the supposition that the sun is due east at six o'clock in the morning, and due east at six o'clock in the evening, all the year round. A moment's study of Fig. 2 which gives the sun's path *M O m* among the stars (as well as the moon's), shows that the points occupied by the sun at six morning and evening, which of course lie along the circle *P O P*′ (since this circle divides every transverse semicircle as *a c a*′, *M O m*′ into equal arcs) are to the north of east and west from the vernal equinox to the autumnal, and to the south, of east and west from the autumnal equinox to the vernal.

† The sun when at the corresponding part of *his* orbit, namely at the vernal equinox, rises earlier by about $2\frac{1}{2}$ minutes on successive days and sets about $2\frac{1}{2}$ minutes later, so that the interval between successive sunrises is less at this time than a mean solar day and at

This happens once in every sidereal lunar month, and may happen more than once in each ordinary lunar month, because the sidereal month is shorter than the lunation, and if the moon is at O very soon after the beginning of a lunation she will be again at O very soon after the end of the lunation,—or pass O twice in that lunar month. But it *must* happen once at least.

We only notice the successive risings of the moon at nearly the same hour, however, when she is conspicuous,—that is, when she is full. We have to consider then at what part of the year she will be full when at O (on the farther hemisphere of Fig. 2), crossing the equator ascendingly, or from south to north. This is a simple matter to determine. As the moon is opposite the sun when full, it follows (since her path is, nearly enough for our present inquiry the same as the sun's), that if when full she is crossing the equator ascendingly from south to north, he must be near the opposite part of their common path, or crossing the equator descendingly from north to south. This is where the sun is at the time of the autumnal equinox. Consequently that full moon which occurs nearest to the autumnal equinox, or say to September 23 or 24, is the full moon which of all the full moons in the year rises on successive nights most nearly at the same time. [I am quite aware of the inexactness of the wording in this sentence. The moon is only full at a certain moment. But I am speaking of phenomena as seen by harvestmen and field labourers, to whom the moon is full as long as her face looks round.]

The full moon which thus rises nearly at the same time on successive nights is called the harvest moon, because her so rising is often convenient to harvest men. Often however, (oftener indeed than not to the harvest men at any given spot) the harvest moon occurs at such a time as not to be of any special use in the way indicated. For instance where I am writing (on September 6th) the harvest is already gathered,—the moon being not as yet half full. Harvest moon occurs on the 16th and will be of no special advantage in this locality. *Last* full moon, which was not harvest moon, was good enough in many places to serve all the purposes of a harvest moon.

To correspond to lower latitudes than ours, the point S in Fig. 2 should be taken lower and the point N higher. For higher latitudes the point S should be higher and the point N lower. For the Arctic circle the point S should be at M′ the point N at *m*′.

The same reasoning applies, with a change of seasons by half a year, to the southern hemisphere. The same figure would serve in fact if S and N be interchanged. The harvest moon is manifestly as useful in the southern hemisphere as in the northern, and within similar limitations. All the lunar phenomena in the southern hemisphere are precisely the same for every latitude as for the corresponding latitude in the northern hemisphere,—when we simply write southern for northern, and speak of spring, summer, fall, and winter, instead of naming the months (which correspond to different seasons in the two hemispheres).

In the German Empire, exclusive of Hungary, last year 139,452 railroad servants were examined as to their capacity to distinguish colours. Of these, the *Railroad Gazette* says, 998, or 0·72 per cent., were found to be colour blind. Of 115,154 examined this year, only 46 were wholly and 273 partly colour-blind—0·28 per cent. of the whole number.

its shortest, while the interval between successive sunsets is greater than a mean solar day, and at its longest.

THE CHEMISTRY OF COOKERY.

XVIII.

By W. Mattieu Williams.

I FIND that Sir Henry Thompson, in a lecture delivered at the Fisheries Exhibition, and now reprinted, has invaded my subject, and has done this so well that I shall retaliate by annexing his suggestion, which is that fish should be *roasted*. He says that this mode of cooking fish should be general, since it is applicable to all varieties. I fully agree with him, but go a little further in the same direction by including, not only roasting in a Dutch or American oven *before* the fire, but also in the side-ovens of kitcheners and in gas-ovens, which, when used as I have explained, are roasters, *i.e.*, they cook by radiation, without any of the drying anticipated by Sir Henry.

The practical housewife will probably say this is not new, seeing that people who know what is good have long been in the habit of enjoying mackerel and haddocks (especially Dublin Bay haddocks) stuffed and baked, and cod's heads similarly treated. The Jews do something of the kind with halibut's head, which they prize as the greatest of all piscine delicacies. The John Dory is commonly stuffed and cooked in an oven by those who understand his merits.

The excellence of Sir Henry Thompson's idea consists in its breadth as applicable to *all fish*, on the basis of that fundamental principle of scientific cookery on which I have so continually and variously insisted, viz., the retention of the natural juices of the viands.

He recommends the placing of the fish entire, if of moderate size, in a tin or plated copper dish adapted to the form and size of the fish, but a little deeper than its thickness, so as to retain all the juices, which by exposure to the heat will flow out; the surface to be lightly spread with butter and a morsel or two added, and the dish placed before the fire in a Dutch or American oven, or the special apparatus made by Burton of Oxford street, which was exhibited at the lecture.

To this I may add, that if a closed oven be used, Rumford's device of a false bottom, shown in Fig. 3, of No. II of this series, should be adopted, which may be easily done by simply standing the above-described fish dish, with any kind of support to raise it a little, in a larger tin tray or baking dish, containing some water. The evaporation of the water will prevent the drying up of the fish or of its natural gravy; and if the oven ventilation is treated with the contempt I have recommended, the fish, if thick, will be better cooked and more juicy than in an open-faced oven in front of the fire.

This reminds me of a method of cooking fish which, in the course of my pedestrian travels in Italy, I have seen practised in the rudest of osterias, where my fellow guests were carbonari (charcoal burners) waggoners, road-making navvies, &c. Their staple "*magro*," or fast-day material, is split and dried cod-fish imported from Norway, which in appearance resembles the hides that are imported to the Bermondsey tanneries. A piece is hacked out from one of these, soaked for awhile in water, and carefully rolled in a piece of paper saturated with olive oil. A hole is then made in the white embers of the charcoal fire, the paper parcel of fish inserted and carefully buried in ashes of selected temperature. It comes out wonderfully well-cooked considering the nature of the raw material. Luxurious cookery *en papillote* is conducted on the same principle and especially applied to red mullets, the paper being buttered and the sauce enveloped with the fish. In all these cases the retention of the natural juices is the primary object.

I should add that Sir Henry Thompson directs, as a matter of course, that the roasted fish should be served in the dish wherein it was cooked. He suggests that "portions of fish, such as fillets, may be treated as well as entire fish; garnishes of all kinds, as shell-fish, &c., may be added, flavouring also with fine herbs and condiments according to taste." "Fillets of plaice or skate with a slice or two of bacon; the dish to be filled or garnished with some previously-boiled haricots," is wisely recommended as a savoury meal for a poor man, and one that is highly nutritious. A chemical analysis of sixpennyworth of such a combination would prove its nutritive value to be equal to fully eighteenpennyworth of beefsteak.

Some people may be inclined to smile at what I am about to say, viz., that such savoury dishes, serving to vary the monotony of the poor hard-working man's ordinary fare, afford considerable moral, as well as physical, advantage.

An instructive experience of my own will illustrate this. When wandering alone through Norway in 1856 I lost the track in crossing the Kyolen fjeld, struggled on for twenty-three hours without food or rest, and arrived in sorry plight at Lom, a very wild region. After a few hours' rest I pushed on to a still wilder region and still rougher quarters, and continued thus to the great Jostedal table-land, an unbroken glacier of 500 square miles; then descended the Jostedal itself to its opening on the Sogne fjord—five days of extreme hardship with no other food than flatbrod (very coarse oatcake), and bilberries gathered on the way, varied on one occasion with the luxury of two raw turnips. Then I reached a comparatively luxurious station (Ronnei), where ham and eggs and claret were obtainable. The first glass of claret produced an effect that alarmed me—a craving for more and for stronger drink, that was almost irresistible. I finished a bottle of St Julien, and nothing but a violent effort of will prevented me from then ordering brandy.

I attribute this to the exhaustion consequent upon the excessive work and insufficient unsavoury food of the previous five days; have made many subsequent observations on the victims of alcohol, and have no doubt that overwork and scanty, tasteless food is the primary source of the craving for strong drink that so largely prevails with such deplorable results among the class that is the most exposed to such privation. I do not say that this is the only source of such depraved appetite. It may also be engendered by the opposite extreme of excessive luxurious pandering to general sensuality.

The practical inference suggested by this experience and these observations is, that speech-making, pledge-signing, and blue-ribbon missions can only effect temporary results unless supplemented by satisfying the natural appetite of hungry people by supplies of food that is not only nutritious, but savoury and *varied*. Such food need be no more expensive than that which is commonly eaten by the poorest of Englishmen, but it must be far better cooked.

Comparing the domestic economy of the poorer classes of our countrymen with that of the corresponding classes in France and Italy (with both of which I am well acquainted), I find that the raw material of the dietary of the French and Italians is inferior to that of the English, but a far better result is obtained by better cookery. The Italian peasantry are better fed than the French. In the poor osterias above referred to, not only the Friday salt fish, but all the other viands were incomparably better cooked than in corresponding places in England, and the variety was greater than is common in many middle-class houses. The ordinary supper of the "roughs" above-named was of three courses, first a "*minestra*," *i.e.*, a soup of some kind, continually varied, or a savoury dish of maccaroni; then a ragout or savoury stew of vegetables and meat, followed by an excellent salad; the beverage a flask of thin but genuine wine. When I come to the subject of cheese, I will describe their mode of cooking and using it.

My first walk through Italy extended from the Alps to Naples, and from Messina to Syracuse. I thus spent nearly a year in Italy during a season of great abundance, and never saw a drunken Italian. A few years after this I walked through a part of Lombardy, and found the little osterias as bad as English beershops or low public-houses. It was a period of scarcity and trouble, "the three plagues," as they called them—the potato disease, the silkworm fungus, and the grape disease—had brought about general privation. There was no wine at all; potato spirit and coarse beer had taken its place. Monotonous "polenta," a sort of paste or porridge made from Indian corn meal, to which they give the contemptuous name of "miserabile," was then the general food, and much drunkenness was the natural consequence.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

(*Continued from page* 138).

THE EVOLUTION OF CONDUCT.

Chapter III.

But within a race and in the relations of the race to other races, there are causes which influence the evolution of conduct. Members of a race fight out the contest for existence not alone but more or less in the presence of their fellows and in the presence of members of other races. Each individual in providing for his own wants or for his own defence affects more or less others, either of his own race or of other races, in their efforts to defend or sustain *their* lives. Very often, as Mr. Herbert Spencer quaintly puts it, "a successful adjustment by one creature involves an unsuccessful adjustment made by another creature, either of the same kind or of a different kind." The lion and the lamb, for instance, already anticipate the millennium; but the lion adjusts matters so much more successfully than the lamb, as to take the outside place; the lamb lies down with the lion, but—inside. Among all races, herbivorous as well as carnivorous, similar relations exist. The more vigorous get the better food, food which the weaker contend for in vain or have to resign, when obtained, to superior strength. Within one and the same race there is still the same law. The stronger monopolise, if they can, the feeding grounds of the race. The weaker, whether originally so, or become so through age or disease, succumb in greater numbers than the stronger in the struggle for existence. Only, while the death of those weak through age does not affect the evolution of the race, the greater mortality among those originally weaker than the rest modifies the race qualities.

In these contests conduct plays an important part. Unnecessary contests involve unnecessary risks. That conduct must prevail best in the long run, and therefore that conduct must eventually be evolved and developed, by which adjustments for the advantage of one creature do not needlessly interfere with adjustments for the advantage of other creatures. If we imagine a carnivorous animal carefully limiting his search for animal food to his requirements, not killing where there was no occasion, and keeping carefully all food he had once obtained, we see that his chances in the life struggle would

be better than those of a carnivore of the same race who killed whenever he got the chance. It would be more the interest of other creatures (as for instance those who wanted the same sort of food) to eliminate the carnivore of the latter sort, than to remove the more prudent member of the race. In the long run this would tell even among the lower animals. But as we approach the relations of men to men and men to animals, we see more obviously how conduct in which the interests or the wants of others are considered is safer in the long run, more conducive (in hundreds of ways more or less complex) to prolonged existence, than conduct in which those interests and wants are neglected. Hence there will be a tendency, acting slowly but surely, to the evolution of conduct of the former kind. More of those whose conduct is of that character, or approaches that character, will survive in each generation, than of those whose conduct is of an opposite character. The difference may be slight, and therefore the effect in a single generation, or even in several, may also be slight; but in the long run the law must tell. Conduct of the sort least advantageous will tend to die out, because those showing it will have relatively inferior life chances.

Mr. Spencer seems to me to leave his argument a little incomplete just here. For though he shows that conduct avoiding harm to others, in all races, must tend to make the totality of life larger, this in reality is insufficient. He is dealing with the evolution of conduct. Now, to take a concrete example, those of the hawk tribe who left little birds alone, except when they had no other way to keep themselves alive but by capturing and killing them, would help to increase the totality of life, by leaving more birds to propagate their kind than would be left if a more wholesale slaughter were carried out. But this of itself would not tend to develop that moderation of hawk character which we have imagined. The creatures helped in the life struggle would not be the hawks (so far as this particular increase in the totality of life was concerned) but the small birds; and the only kind of moderation or considerateness encouraged would be shown in a lessening of that extreme diffidence, that desire to withdraw themselves wholly from hawk society, which we recognise among small birds. But if it be shown that the more wildly rapacious hawks stand a greater chance of being destroyed than those of a more moderate character, then we see that such moderation and steadiness of character is likely to be developed and finally established as a characteristic of the more enduring races of hawks. And similarly in other such cases.

It is, however, in the development of conduct in the higher races only, that this comparatively elaborate law of evolution is clearly recognised. Among savage races we still see apparent exceptions to the operation of the rule. Individuals and classes and races distinguished by ferocity and utter disregard of the "adjustments" of others, whether of their own race or of different races, seem to thrive well enough, better even than the more moderate and considerate. Forces really are at work tending to eliminate the more violent and greedy; but they are not obvious. As society advances, however, even this seeming success of the rapacious is found to diminish, though as yet there has been no race or society from which it has been actually eliminated. Conduct which is imperfect, conduct characterised by antagonisms between groups and antagonisms between members of the same group, tends to be more and more reduced in amount, by the failure or by the elimination of those who exhibit such conduct. What is regarded as gallant daring in one generation is scorned as ferocity in a later one, resisted as rapacious wrong doing yet later, and later still is eliminated either by death or nearly as effectually (when indirect as well as direct consequences are considered) by imprisonment.*

As violence dies out, and as war diminishes,—which usually is but violence manifested on a larger scale,—the kind of conduct towards which processes of evolution appear to tend, "that perfect adjustment of acts to ends in maintaining individual life and rearing new individuals, which is effected by each without hindering others from effecting like perfect adjustments," will be approached. How nearly it will ever be attained by any human race—*Quien sabe?*

One further consideration, and we have done with the evolution of conduct, the right understanding of which is essential to the scientific study of conduct. The members of a society while attending to adjustments necessary for their wants or interests, may not merely leave others free to make their adjustments also, but may help them in so doing. It is very obvious that conduct thus directed must tend to be developed. As Mr. Spencer says, such conduct facilitates the making of adjustments by each and so increases the totality of the adjustments made and serves to render the live of all more complete. But besides this (as he should also have shown, since it is an essential part of the evolution argument), it tends to its own increase: for, being essentially mutual, conduct of this kind is a favourable factor in the life struggle.

We have next to consider what, seeing thus the laws according to which conduct is evolved, we are to regard as good conduct and bad conduct.

(*To be continued.*)

"The world embraces not only a Newton, but a Shakespeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these but in all, is human nature whole. They are not opposed, but reconcilable—not mutually exclusive, but supplementary."—John Tyndall.

"When the Hebrew prophet declared that 'by him were laid the foundations of the deep,' but reminded us, 'Who by searching can find him out?' he meant pretty much what Mr. Spencer means when he speaks of a power that is inscrutable in itself, yet is revealed from moment to moment in every throb of the mighty rhythmic life of the universe."—John Fiske.

"Joyfully accepting modern science, and loyally following it without the slightest hesitation, there remains ever recognised still a higher flight, a higher fact, the eternal soul of man, (of all else, too,) the spiritual, the religious, which is to be the greatest office of scientism, in my opinion, and of future poetry also, to free from fables, crudities and superstitions, and launch forth in renewed faith and scope a hundred fold. . . . To me the crown of savantism is to be, that it surely opens the way for a more splendid theology and for ampler and diviner songs." Walt Whitman.

The Tricycle.—The article on "High Wheels *v.* Low Wheels" referred to by Mr. John Browning in this week's Knowledge appeared in No. 8, Vol. II., of G. L. Hillier's Journal.

* Many overlook the bearing of imprisonment on the evolution of conduct, its influence (when long terms are considered) in diminishing the numerical increase of particular types of character and therefore in diminishing the quantity of particular forms of conduct.

EVOLUTION OF HUMAN PHYSIOGNOMY.

By E. D. COPE.

(Continued from page 137.)

IF we now examine the leading characters of the physiognomy of three of the principal human sub-species, the Negro, the Mongolian, and the Indo-European, we can readily observe that it is in the two first-named that there is a predominance of the quadrumanous features which are retarded in man; and that the embryonic characters which predominate are those in which man is accelerated. In race description the prominence of the edges of the jaws is called prognathism (forward jaws), and its absence orthognathism (straight jaws). The significance of the two lower race characters as compared with those of the Indo-European, is as follows:—

Negro.—Hair crisp (a special character), short (quadrumanous acceleration); prognathous (quadrum. accel.); nose flat, without bridge (quadrum. retard.)*; malar bones prominent (quadrum. accel.); beard short (quadrum retard.); arms longer (quadrum. accel.); extensor muscles of legs small (quadrum. retard.).

Fig. 5.—Profile of a Luchatze negro woman, showing deficient bridge of nose and chin, and elongate facial region and prognathism.

Mongolian.—Hair straight, long (accel.); jaws prognathous (quadrum. accel.); nose flat or prominent with or without bridge; malar bones prominent (quadrum accel.); beard none (embryonic); arms shorter (retard.); extensor muscles of leg smaller (quad. retard.).

Indo-European.—Hair long (accel.); jaws orthognathous (embryonic retard.); nose (generally) prominent with bridge (accel.); malar bones reduced (retard.); beard long (accel.); arms shorter (retard.); extensor muscles of the leg large (accel.).

The Indo-European race is then the highest by virtue of the accelleration of growth in the development of the muscles by which the body is maintained in the erect position (extensors of the leg), and in those important elements of beauty, a well-developed nose and beard. It is also superior in those points in which it is more embryonic than the other races, viz., the want of prominence of the jaws and cheek-bones, since these are associated with a greater prominence of the cerebral part of the skull, increased size of cerebral hemispheres, and greater intellectual power.

A comparison between the two sexes of the Indo-Europeans expresses their physical and mental relations in a definite way. I select the sexes of the most civilised races, since it is in these, according to Broca and Topinard, that the sex characters are most pronounced. They may be contrasted as follows. The numbers are those of the list on page 136 already used. I first consider those which are used in the tables of embryonic, quadrumanous, and race characters:—

MALE.	FEMALE.
I. The General Form.	
2. Shoulders square.	Shoulders sloped.
4. Waist less constricted.	Waist more constricted.
5. Hips narrower.	Hips wider.
6. Legs longer.	Legs shorter.
8. Muscles larger.	Muscles smaller.
II. The Integuments, etc.	
10. More hair on body, that of head shorter; beard.	Less hair on body, that of head longer; no beard.
12. Skin rougher (generally).	Skin smoother.
III. The Head and Face.	
16. Superciliary ridges more prominent.	Superciliary ridges low.
22. Eyes often smaller.	Eyes often larger.

Fig. 6.—Face of another negro, showing flat nose, less prognathism and larger cerebral region. From Serpa Pinto.

The characters in which the male is most like the infant are two, viz., the narrow hips and short hair. Those in which the female is most embryonic are five, viz., the shorter legs, smaller muscles, absence of beard, low superciliary ridges, and frequently larger eyes. To these may be added two others not mentioned in the above lists; these are (1) the high-pitched voice, which never falls an octave as does that of the male; and (2) the structure of the generative organs, which in all mammalia more nearly resemble the embryo and the lower vertebrata in the female than in the male. Nevertheless, as Bischoff has pointed out, one of the most important distinctions between man and the apes is to be found in the external reproductive organs of the female.

From the preceding rapid sketch the reader will be able to explain the meaning of most of the peculiarities of face and form which we meet with. Many persons possess at least one quadrumanous or embryonic character. The strongly convex upper lip frequently seen among the lower classes of the Irish is a modified quadrumanous character. Many people, especially those of the Sclavic races, have more or less embryonic noses. A retreating chin is a

* In the Bosjesman the flat nasal bones are coössified with the adjacent elements, as in the apes (Thulié).

marked monkey character. Shortness of stature is mostly due to shortness of the femur, or thigh; the inequalties of people sitting are much less than those of people standing. A short femur is embryonic; so is a very large head. The faces of some people are always partially embryonic, in having a short face and light lower jaw. Such faces are still more embryonic when the forehead and eyes are protuberant. Retardation of this kind is frequently seen in

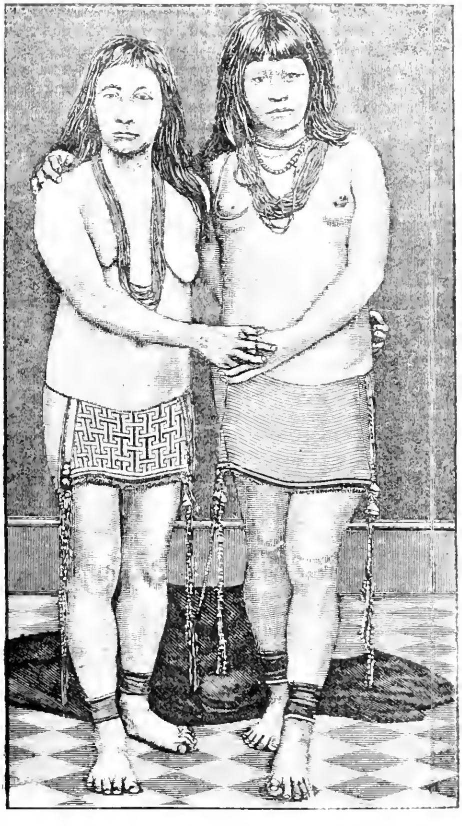


Fig. 7.—Esequibo Indian women, showing the following peculiarities: deficient bridge of nose, prognathism, no waist, and (the right-hand figure) deficiency of stature through short femur. From photographs by Endlich.

children, and less frequently in women. The length of the arms would appear to have grown less in comparatively recent times. Thus the humerus in most of the Greek statues, including the Apollo Belvidere, is longer than those of modern Europeans, according to a writer in the "Bulletin de la Société d'Anthropologie," of Paris, and resembles more nearly that of the modern Nubians than any other people. This is a quadrumanous condition. The miserably developed calves of many of the savages of Australia, Africa, and America, are well known. The fine swelling gastrocnemius and soleus muscles characterise the highest races, and are most remote from the slender shanks of the monkeys. The gluteus muscles developed in the lower races as well as in the higher, distinguish them well from the monkeys with their flat posterior outline.

Fig. 8.—Portrait of Satanta, a late chief of the Kiowas (from the Red River of Texas), from a photograph. The predominance of the facial region, and especially of the malar bones, and the absence of beard, are noteworthy.

Some of these features have a purely physical significance, but the majority of them are, as already remarked, intimately connected with the development of the mind, either as a cause or as a necessary coincidence.

TRICYCLES.

THE article in Knowledge (No. 96) from the able pen of Mr. Browning prompts me, a rider of some fifteen years' experience of both bicycle and tricycle, to address you a few remarks upon the same subject, as I fear that Mr. Browning's deductions have led him to enounce theories concerning tricycles which, if acted upon by the novice, will assuredly cause him to become disgusted with his first efforts.

Small wheels are a great mistake from every point of view, and it is far easier to propel a machine with 50-inch wheels geared down to, say, 42, than it would be to drive a machine of even less weight with 36-inch wheels.

It is absurd to talk of anyone being content with a speed of four or five miles an hour, as such a pace can only lead to the rider becoming disgusted with the affair altogether.

It is as easy to ride a machine with large wheels at the rate of seven or eight miles an hour as it would be to ride one with 36-inch wheels at the rate of four miles an hour; nay, easier.

A man perched upon a machine with such small wheels looks as if riding a child's go-cart, and is hailed with derision by the drivers of carts, who are much more likely to give way to a machine that they can see is a vehicle than

to take any note of a thing that creeps along at the rate of four miles an hour and has toy wheels.

To a rider of even average strength there are very few hills that need be walked, and those only the very steep ones, and it is a mistake to inculcate the impression that one mile in ten has to be walked. I have a great regard for Mr. Browning, but feel compelled to endeavour to set aside such fallacies as this, as I think they must serve as a deterrent to would-be cyclists.

The fact that Mr. Browning finds this to be the case is in itself enough to condemn the type of machine he advocates, as it is certainly not my experience, nor is it the experience of anyone I know, neither will it be the experience of anyone who possesses even an ordinary amount of strength.

I know an aged clergyman, very nervous and very feeble. When he first commenced to ride, he, of course, found it rather trying to ride the steepish hills in the north of London, but now he goes on his way, and very seldom walks up any but the very steepest of hills.

Anyone who wishes to begin to ride a tricycle will inevitably ere long strive to improve his pace, no matter how meek his preliminary aspirations may be; but if he starts with a very small wheel he will never be able to improve his speed, but will be a perpetual snail along the road until he goes to the further expense of a new machine. If, on the other hand, he at the outset goes in for a machine that will travel fast at pleasure, he can ride it as fast as he pleases or as slow as he pleases.

It follows as a mere matter of course that a machine that can be driven at a very high rate of speed must from that very fact be an easy running machine, as otherwise it could not be driven at a fast speed. Therefore, this is the machine to select, and while going slowly the utmost ease of propulsion is existent; and it is, at the same time, always possible to improve the speed as experience is gained.

To recapitulate, a fast machine must *ipso facto* be an easy machine to propel.

I fully endorse Mr. Browning's view as to lightness, as I have always urged this as a *sine quâ non—i.e.*, for a not too heavy rider, and I myself ride an Imperial Club which weighs under 60 lb., and yet it has 50 in. wheels. This machine is geared up to a 60 in., and still I ride all the hills I come to, seldom or ever dismounting; and I have several times ridden nearly, and even over, 100 miles a day. This machine is as easy to drive and as fast as a bicycle, and I can always hold my own on the road with anything, and yet when simply riding slowly I can move along with the slightest possible exertion.

Nothing wearies so much as rapid pedalling, and nothing looks so ungraceful; and it is obvious that with small wheels the pedalling must be very rapid indeed to get any pace at all. With my machine, however, my feet pass very slowly round and round, and still the gearing up (which, of course, consists in having the lower chain wheel larger than the top one; so that the wheels go round faster than the feet and the pedals) always keeps up a fair pace, and this is attained without fast pedalling.

The machine that I am sure will give the best result will be one weighing little, and that has wheels no less than 48 in. in diameter, and if this be fitted with the recently-perfected "speed-gear," either a fast speed or a low speed can be used for the level or for mounting hills, as the case may be.

I fear that I have already trespassed too far upon your space, but there are several other points which might have been dilated upon for the advantage of your readers, many of whom are absolutely certain to "go in" for tricycles when they realise how extremely useful they may be made for exploring the country and for means of exercise.

Sigma.

WINDS AS PROJECTILES.

M. J. C. Houzeau, referring to observations on the formation of clouds made by MM. Lancaster and Tempel, and by Mr. R. T. Armstrong, communicates to *Ciel et Terre* an article on "The Nature of Wind." He remarks that although wind is air in movement, the movement cannot be likened to that of a liquid sheet of vast extent, nor to that of a vein of liquid, nor to that of the sea-waves. If the air flow were in vast continuous sheets, its pressure would only vary slightly and gradually over the area it acted upon. It would not exhibit abrupt changes and intermittences. The aspect of a field of wheat on which the wind blows suffices to show that the air neither moves as a sheet nor as a vein.

In squalls there is often complete repose between the blasts. On Nov. 11, 1878, M. Houzeau witnessed a remarkable instance of this about 200 kilomètres south of the Lizard. The puffs were of extreme violence, while in the intervals the air scarcely moved. These intermittences, although reminding him of waves bursting on a shore, could not be considered like them. Between two succeeding sea-waves there is no water; the hollow is filled with air; if it were occupied with the former fluid the intermittence would give place to continuous action. But between the wind blasts there is air, which is not carried on with them. M. Houzeau does not deny that there is often a general movement of translation of air, as a proper motion, or as the result of blasts dragging it with them; but the phenomenon appears to him to consist of the movements of detached masses, which, to give precision to the idea, he compares with projectiles traversing the general mass of the atmosphere. The limited area to which storm-action is often confined, bending some trees violently and not affecting their neighbours, shows that these aërial projectiles have little breadth. Another fact, he considers, points to the same conclusion, for, if when the wind is strong, its pressure per square mètre is observed on anemometers of different sizes, the larger ones show the highest proportional results. The greater the surface, the greater the chance of its receiving the shock of the projectiles. If there were no divisions in the air-streams, the pressure per square mètre would be independent of the dimensions of the anemometer plates.

The friction of air is so slight that there is nothing astonishing in the feeble entraining power of the projectiles. What is less easy to conceive is the nature of the force which impresses upon sharply-defined portions of air the furious velocities which sometimes animate them. But before attacking this question Mr. Houzeau advises studying what may be called the texture of the air in tempests, and to ascertain the number, dimensions, and relative spacing of these projectiles which traverse the atmosphere as a kind of *mitraille*.

If, as M. Houzeau states, it is a general fact in storms that large anemometers show a much greater average pressure than small ones, it is evident that calculations founded upon the velocities of the cups usually employed give no indication of the resisting power required to prevent a recurrence of such incidents as the Tay Bridge disaster. But M. Houzeau should indicate the experiments upon which he bases this statement, as exactly the opposite is affirmed by other persons.

DANGERS OF SEA-BATHING.

WE have recently had evidence of the three chief dangers of sea-bathing. First it was a case akin to the fatal bath of Alexander the Great, where death was caused by suddenly plunging the body, when hot and tired, into very cold water. Then came a case in which cramp affecting all the lower part of the body caused death. Lastly, at Eastbourne, on Sunday, August 26, a young man was drowned through bathing too soon after a full meal. It is singular how people underestimate the nature of the trial to which they expose their bodies in sea-bathing. The trial is indeed one which can be borne safely by any one in average health, under reasonable conditions. But even for the healthy it involves a shock, the reaction from which is what does good, not the shock itself, which so far as it goes tends to lower the vital energies. But to plunge into cold water when the vital energies are already below par, or under conditions which are likely to overtax the force of reaction is dangerous in the extreme. Another dangerous practice is that of staying in the water too long. To sea-bathing for the health Hesiod's old saying may be applied. Half is better than the whole, when the whole means the full time which the bather can stay in the water without suffering. If a man can bear twenty minutes in the water he will do well to take but ten; if he can bear ten, to take but five. When he stays in the water for the shorter period he comes forth braced up and invigorated; when he keeps in as long as he can bear the cold he comes out at last tired and wearied, feels depressed and languid for hours or perhaps for the rest of the day, and probably suffers from headache or other evidence that the nervous energies have been overtaxed.—*Newcastle Chronicle.*

Editorial Gossip.

IT is hard when some quality—mental, moral, or physical—on the strength of which any one has come before the public—is specially criticised as the one quality in which such person is deficient. For instance, let us suppose that when Disraeli told his constituents that "he 'stood' on his head" some one had rudely remarked that that was his weakest place: this would have been as hard as it would have been untrue. So, if I were told in connection with my teachings in astronomy, that astronomy is just the subject in which I am most ignorant, I suppose I should not be greatly pleased: even if I were modest enough to admit the soft impeachment, I should be pained at the thought that my special ignorance on that subject had remained so long unknown to me. It occurs to me to note, by the way, that only a day or two since I came across a passage in the *Ottawa Free Press* from which I learned that Mr. Wiggins, the predictor of the famous storm which was to have destroyed every ship at sea last March, but somehow failed to do so, had pointed out so far back as 1876 my ignorance of astronomy. I had lectured at St. John's, N.B.,—I remember well that mild Christmas time (where I had expected intense cold, but walked from my lecture, in evening dress, with overcoat over my arm); and I remember too my kindly greeting there. I had said in the course of my lecture that the moon has very little if any atmosphere. But next day (when I was half way towards New York) Mr. Wiggins observed that as the moon reflects sunlight she must have an atmosphere of considerable density, and also showed how ignorant I must be not to know that. So he found out that when I slightly criticised his storm-prediction, casually referring to knavery or folly in explanation thereof—I had been lying in wait six or seven years to attack him. "All this time," he says "the Professor has lain in his lair"! &c. It will be seen that I know or ought to know how painful must be a charge of shortcoming in some quality where one had imagined oneself rather exceptionally well off. I can sympathise therefore with Mr. Oscar Wilde when a play of *his* is condemned for vulgarity and coarseness by the Americans whom he sought to soften and harmonise. And now more distressing news still comes from across the Atlantic. A person went over there not on the strength of head or understanding (other than legs and feet) but trusting to beauty of limb and charm of manner; and here is the *Courier Journal*, of Louisville, Ky., rejoicing that those hideous limbs and monstrous hands and feet are gone from out the land. But the Kentuckian—who usually sits on five chairs at once, so long is he of limb, and so expansive in manner—is unusually critical about feminine hands and feet. The ladies of Kentucky are singularly favoured by nature in that respect, insomuch that though the feet (for instance) of an average St. Louis lady would not be thought large in England it is a standing joke in Louisville, Ky. that St. Louis shoes sent to the Centennial Exhibition, were by a natural mistake placed in the canoe department. Still the Kentuckian paper has not been over-polite to our English visitor, who rather "stood" on her feet.

MR. ROMEIKE, whose "Artistic and Literary Correspondence" I am willing enough to advertise gratis, seems determined to show me that I ought to recognise the value of his agency for distributing press notices to those mentioned in them. I was hard-hearted enough to say that these were things to be avoided rather than sought. He suggested in reply that though I might receive numbers of ordinary notices from publishers, I might not see those which attacked me, and he implied that these were more numerous by far than I probably imagined. Now my own idea has been, and is, that that ancient institution (*vide* Job *passim*) the "d—d—*dear* good-natured friend," had long since anticipated Mr. Romeike's agency, and that I need not fear lest anything unpleasant about myself should fail to reach me. But Mr. Romeike thinks differently; so, though I had expressed no burning desire to see such notices, he has sent me all he has come across,—to wit, within the last six months *two* out of seven (all the seven having reached me earlier through the D. G. N.). The last he sends me is rather pleasant than otherwise, only Mr. Romeike carefully underlines (courteous gentleman that he is) the parts which he thinks likely to hurt. Here is the passage, as it appears in *Life*, except only that those words which the gentlemanly Mr. Romeike underlines for my benefit appear here in italics:—

"A paper on 'Poker Principles and Chance Laws,' by Mr. R. A. Proctor, whose right to discuss this topic, otherwise indisputable, would be fortified, in case it needed fortification, by his famous victory over 'Boss.' *Unhappily Mr. Proctor's many-sided accomplishments do not include an accurate knowledge of his native tongue.* In this article, for instance, he talks of 'the *verbiage* of Poker' and of 'astrological *verbiage*,' where a more correct writer would have substituted the word 'terminology' or 'nomenclature,' or, more appropriately, if less elegantly, 'slang,' for that which we have italicised. Furthermore, to pass from mere verbal criticism to more important matters, it appears to us, though we say so with the utmost diffidence, that Mr. Proctor's statement on page 503, to the effect that the odds against the throwing of 'size' after five 'sizes' have been already thrown, are only five to one, involves a *gross fallacy*. True, to any one ignorant of the preceding throws, the odds against 'size,' or any particular number, turning up are five to one. But to any one who knows that 'size' has already

been thrown five times running—and this is the very case with which Mr. Proctor is dealing—the odds against 'size' recurring on the sixth cast are not five to one, but forty-six thousand six hundred and fifty-six to one. This is so bold a challenge of Mr. Proctor's accuracy that we hasten to shelter ourselves under the authority of John Stuart Mill, in whose 'Logic' (Vol. II., page 75, 7th edition) the principle for which we are contending is laid down. For the rest, Mr. Proctor's article is well worth reading; all the more, on account of the high moral tone which pervades it."

WELL, the only fault here is that the critic, whom I suppose to be a little inexperienced, generalises from a single observation, asserting general inaccuracy on the strength of a single slip (as he supposes my use of the word "verbiage" to be). As to this word, which was first used (and invented) by Samuel Johnson, it is commonly defined, I know, as meaning merely "wordiness." Johnson himself did not use it in that sense. If he had meant "wordiness" he would have used the older word "verbosity." My critic evidently thinks "verbosity" and "verbiage" the same, as many do who ought to know better—some dictionary-makers to wit. I prefer to use the word as a more convenient form than "terminology" or "nomenclature." Besides it chanced (a mere detail) that I did not *mean* terminology or nomenclature. "Slang" would not have suited me at all. A word so recently introduced into our language as "verbiage" is not quite so definitely fixed in meaning as my critic imagines, nor to be too readily made identical with another much older word ("verbosity") the existence of which is enough to show that "verbiage" as used by Johnson (who knew all about verbosity) had a different significance.

As for the "gross fallacy,"—if John Stuart Mill has in his "Logic" said that the chance of throwing "size" after "size" has been, and is known to have been, already thrown five times running, is 46,656 to 1, that would only illustrate the fact, already known, that Mill's mathematical conceptions were inexact. The odds are not even 46,656 to 1, but 46,655 to 1 against throwing "size" six times running. But to make the odds the same against throwing a sixth "size" after five already thrown, as they are against throwing "size" six times running, would be so gross and palpable a blunder, that I cannot imagine Mill ever imagined it. It is hardly necessary for me to point out that my own statement simply presents the truth as known to every mathematician. But I think I can make the fallacy attributed to Mr. Mill quite clear to my critic. Suppose, in coin-tossing, "head" tossed three times running. According to the view I have presented, the chance of tossing a fourth "head" is simply one half, or the odds for and against are even (1 to 1). According to the view attributed to Mill, as four heads come in succession in only one case out of 16 possible cases, the chance is 1-16, or (making the same confusion between the chance and the odds), my critic would write that the odds are 16 to 1 (instead of 15 to 1, as they would be if the chance is 1 in 16). But half-an-hour's steady tossing will soon convince my critic in *Life* that this is not the case. He will get, perhaps, fifty or sixty cases in which heads or tails come three times at least in succession, and he will find that in about half (*not in about a sixteenth*) of these cases head or tail, as the case may be, is tossed a fourth time. If he would lay a wager of £15 to £1, after every case in which three heads or three tails had appeared, that the fourth tossing would *not* be of the same kind as the three, his opponent would very soon be able to say of the problem—as my critic retreated from before him with empty pockets—*Solvitur ambulando!*

BUT my critic in *Life* speaks with becoming modesty on a subject which—as he seems to admit—he has not very carefully studied. Where we chiefly differ is in this,—I *have* carefully studied it.

As regards "accurate knowledge of my native tongue" (a most inaccurate expression, by the way), I think I may say to my not unkindly critic,—

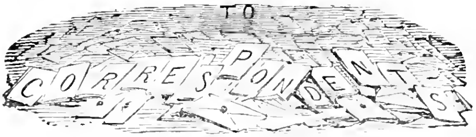
Teach not a parent's parent to extract
The embryo juices of an egg by suction;
The good old lady can the feat enact
Quite irrespective of your kind instruction.

THE FACE OF THE SKY.

FROM SEPT. 14 TO SEPT. 28.

BY F.R.A.S.

THE student will continue to watch the Sun daily for signs of disturbance. Splendid faculæ appear now at intervals on the solar limb. The face of the stellar vault will be found delineated on Map IX. of "The Stars in their Seasons." Mercury is an evening star, but is very close indeed to the horizon at sunset. As Venus comes into superior conjunction with the Sun on the 20th (in other words, is behind him), it is needless to say that she will be invisible during the next fourteen days. Mars rises soon after 11 o'clock at night on the 14th, and between 10 and 11 p.m. by the 28th, half-way between the N.E. and the N.E. by E. points of the horizon. His diameter is slowly increasing, but little or no detail can as yet be made out upon his surface with the telescope. Jupiter rises at half-past 12 o'clock at night on the 14th, and before midnight by the end of September. His path lies in Cancer during our specified period. No fairly observable phenomenon of his satellites occurs during the ordinary working hours of the student's night. Although Saturn is on the meridian during the early morning, yet he rises about 9h. 7m. p.m. on the 14th, and soon after 8h. in the evening of the 28th. With his rings approaching their greatest opening, the planet now presents a spectacle of the highest interest to the observer with the telescope; and is coming into a more favourable position every night. He is above and a little to the left of Aldebaran. Uranus, like Venus, is behind the sun, and, of course, invisible. Neptune in a barren point of Aries is indistinguishable from a telescopic star. The moon is 12·9 days old at noon on September 14, and, quite obviously, 26·9 days old at the same hour on the 28th. The full moon of the 16th is the so-called "Harvest Moon." After the 23rd, she rises too late for the ordinary amateur observer. Occultations of stars by the moon are rather more numerous during the next fortnight. Of those which occur not much later than midnight we may mention that of c^1 Capricorni, a $4\frac{1}{2}$ mag. star, which will disappear at 8h. 44m. p.m. on September 14, at the moon's dark limb, at an angle from her vertex of 171°; reappearing at her bright limb, at a vertical angle of 208°, at 9h. 5m. p.m. On the same night c^2 Capricorni, a 6th mag. star, will disappear at the dark limb at 8h. 47m. at a vertical angle of 91°; and reappear at the bright limb of the moon at 10h. p.m., at an angle of 300° from her vertex. Passing over occultations which happen at 3h. 4m. and 5 a.m., we come to one of the 6th mag. star B.A.C. 1,119 which on the night of the 20th will disappear at the moon's bright limb at 11h. 47m. at an angle of 7 from her vertex to reappear at the dark limb, at an angle from the vertex of 308°, 20 minutes after midnight. Before the moon rises on the 22nd she will have occulted 120 Tauri, a 6th mag. star. Subsequently this will reappear from behind her dark limb at 10h. 19 m. p.m. at an angle of 239° from her vertex. Lastly, on the 24th, 27 minutes after midnight, 68 Geminorum, a star of the $5\frac{1}{2}$ magnitude, will disappear at the bright limb of the moon, at an angle of 30° from her vertex, to reappear at her dark limb at a vertical angle of 213° at 1 h. 19 m. the next morning. The moon occupies all to-day and a great deal of to-morrow in traversing Aquarius, passing into Pisces about 5 a.m. on Sunday, the 16th. It is 4 a.m. on the 19th before she has performed her path across this great constellation and entered Aries. She travels across Aries until 7 p.m. on the 20th, when she passes into the confines of Taurus, her passage across which takes until 6 a.m. on the 23rd. At this hour she enters the northern boundary of Orion, which she occupies twelve hours in crossing, emerging into Gemini about 6 p.m. At noon on the 25th she enters Cancer, which she quits for Leo between 5 and 6 o'clock in the morning on the 27th. At midnight on that day she descends into Sextans. We there leave her.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE BENNETT BATTERY.

[921]—My attention has been called to a paragraph in your issue of Sept. 1st, which contains several grave misstatements in connection with the voltaic battery which bears my name. You are, of course, at liberty to publish the results of honest experiments made with the battery, and to remark thereon in an impartial spirit, but you are not entitled to publish distinct untruths, with the apparent object of injuring it in public estimation. Your contributor states that the battery gives forth an odour of rotten eggs to such an extent as to contaminate the air, and attributes the smell to sulphuretted hydrogen (!) As a matter of fact, the battery is *quite* odourless, and cannot, under any circumstances, emit sulphuretted hydrogen, for the very sufficient reason that there is no sulphur in any form in the cell. Your contributor states that the cell is of no use whatever to anybody. Perhaps you are unaware of the fact that it is in extensive use in Scotland and elsewhere for several purposes, and is giving better results than the Leclanché. An exhaustive comparative trial has been in progress, on a practical scale, since March last, by independent persons in Glasgow, with the result, so far, altogether in favour of my battery as compared with the Leclanché. These results, in a tabulated form, are to be published on the completion of the experiment, which has been prolonged owing to the durability of the battery. The bias of your contributor is evident from the fact that he makes an equally untrue statement regarding the Leclanché battery. He states that, even with hard work, the agglomerate blocks last two years. All practical men know this to be false. With such work as they get in the Glasgow Central Telephone Exchange, agglomerate blocks last from three to four months, and then require complete renewal.

Sept. 5, 1883. A. R. Bennett.

[My remarks on the Bennett cell were based on experiments made upon it some months since. The odour of SH_2 was unmistakable, and I attributed it to the presence of impurities. The cell did not show such good results as were obtainable from the six-rod agglomerate Leclanché, and I could not, therefore, recommend amateurs to adopt the cell. Practical men would judge for themselves. May be the invention of Mr. Bennett has been lately improved. If so, I shall be glad to hear from him, and he will find that no journal is more ready to bestow praise where it is deserved than Knowledge. Anent the durability of the agglomerate, all practical telegraph men praise it highly for what it has done and is still doing. I could have shown Mr. Bennett a number of blocks which had been working hard, night and day, for upwards of eighteen months. The resistance of a telephone line is very low in comparison with the average telegraph line, and that may help to account for the bad result Mr. Bennett has obtained. Or it may be that he has had a large number of short circuits drawing upon one battery at a time.—W. Slingo.]

SMALL WHEELS FOR TRICYCLES.

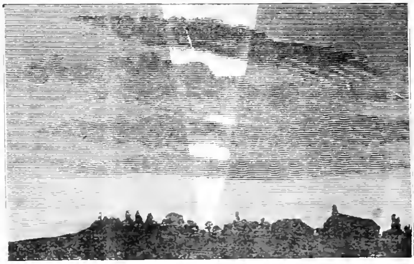
[925]—I am obliged for the reminder of your correspondent "J. S." that the "Sun and Planet" is a small-wheeled bicycle geared-up. I have seen the machine, though I have never ridden it as I have the "Facile." If the merits of the machine are great, it is a pity it is not more advertised, as, being a rotary machine, some would prefer it to any machine with a lever action.

As "J. S." suggests, there may be a great future for small geared-up safety bicycles. Will "J. S." oblige me by stating the true weight, of his own knowledge, of his machine?

I am glad that so thoughtful a rider agrees with my conclusions as to the desirability of reducing the size of the wheels of tricycles. Since my papers on this subject have appeared in Knowledge, I have received assurances from the following well-known riders that they agree with my conclusions:—Messrs. Marriott, Nixon, Letchford, S. Salmon, A. Salmon, and Howard, and also Messrs. Grace and Bennett. It must be recollected that all these riders have tried first large wheels and then small, and have *proved* small to be the best. John Browning.

A CURIOUS PHENOMENON.

[926]—Can any of my brother readers of Knowledge offer a feasible explanation of a very remarkable phenomenon which I witnessed at 10h. 35m. p.m. on Tuesday, August 28? I was just coming out of my observatory when, on the E.N.E. point of the horizon beneath the Pleiades, I saw a bright light. My first thought was that the moon was rising, but an instant's reflection sufficed to remind me that she would not be up for the next two hours. As I watched the light becoming brighter and brighter, I saw that it threw a kind of radial illumination upward, the effect of which I have tried to reproduce in the accompanying rough little sketch.



As will be seen, a few distant cumulo-stratus clouds, close to the horizon, crossed it. For a moment I imagined that I was viewing the apparition of a new and most glorious comet; but, as I watched, the "tail" disappeared, and what would represent the nucleus flashed up brilliantly. Then I made up my mind that some distant house, barn, or haystack was on fire, and returned to the observatory for a 3 inch telescope, which I keep for looking over the landscape. Before I had time, however, to enter the door, every vestige of illumination disappeared as suddenly as it had come into view, and after waiting in vain for some time, I left the observatory and came into the house. I have diligently inquired if there was a fire anywhere in this part of Sussex on the night of which I am speaking, but there was none. Were the Crystal Palace concealed by the high ridge from behind which this strange apparition arose, the concluding burst of a grand pyrotechnic display might reproduce what I witnessed; but merely as a matter of topography the Crystal Palace is not on Ashdown Forest, nor on Crowborough Common (which lies beyond it in an E.N.E. direction from here) either. Nor, oddly enough, does any house, or even any agricultural buildings, lie upon the line drawn from my observatory through the point at which this light arose, as any one may see from the Ordnance Map, whereon, of course, Forest Lodge is marked. I may add that the latitude of the observatory is 51° 0′ 56″ N., and its longitude 17·8″ E. of Greenwich. William Noble.

STORMY PETREL.

[927]—On going into the yard at the back of 13, Guildford-street, Birmingham, about 7.30 a.m. on Sept. 4, I saw a strange bird lying with wings extended, quite dead, but warm. It had evidently dropped from exhaustion. On examination it turned out to be the stormy petrel (*Procellaria pelagica*). I attribute it to the very heavy gales that have occurred lately. You may insert this if you think it will be of interest to any of your readers of Knowledge.

R. W. Burford.

THE COMMA.

[928]—I send you an example of a printer's comma which may interest you: Matthew xxvii. 23, "Why, what evil hath he done?" The original reads, τί γὰρ κακὸν ἐποίησεν. The printer's comma makes a double question and causes the "why" to refer to "Let him be crucified." It is so read by ninety-nine out of a hundred. I trouble you with this, because I believe it is not generally known, and it appears interesting to me. A. H. TAIE WHITE.

A RABBIT'S SKULL.

[929]—I see you have an article in KNOWLEDGE of Aug. 17, on "A Rabbit's Skull." I may here mention that my father has in his possession a skull very similar to that spoken of, but still more interesting, as in this case the top *right* incisor, which is quite three inches in length, has grown right up through the roof of the mouth on the *left* side, and passing down once more, ends just where it began. The one in the lower jaw is an inch and a half long, and has grown out almost straight from the mouth. There appear to be two incisors in the top jaw, but only one in the lower, and, although it was impossible for the front teeth to close, yet the rabbit seemed in perfect health, and was in good condition when shot.

LEILA C.

LIGHT FROM FLOWERS.

[930]—The following extracts from a book entitled "Lessons in Physical Science" (Simpkin, Marshall, & Co., 1872) may meet the wishes of your correspondent (882) on the above subject. They may be found in the chapter commencing at page 151:—

"The spark elicited by stroking the back of a cat, or by the action of an electrical machine, does not differ in its nature from the lightning which flashes from the storm-cloud, nor from the brilliant and variegated auroras which stream through the upper regions of the atmosphere in Polar latitudes, and which, to some extent, compensate, in those dismal abodes of winter, the long absence of the solar beams. To the same source—electricity—we probably owe the light which, at certain seasons, and at certain times of the day, issues from a number of yellow or orange-coloured flowers, such as the marigold, the sunflower, and the orange-lily. The daughter of Linnaeus, the great naturalist, is said to have first observed these sparks and flashes playing about garden flowers during the summer twilight of 1762, but similar phenomena have been witnessed by several naturalists. Flashes, more or less brilliant, have been seen to dart in rapid succession from the same flower. At other times the tiny flame-jets have followed one another at intervals of several minutes. . . . Sir H. Marsh gives an account of a female about whose head strange luminous appearances were observed. Shortly before her death several attendants saw a pale bluish light, like that of the moon, proceed from her head; and Professor Donovan witnessed, in the case of a man in the later stages of consumption, mysterious lights, once in the form of a luminous fog, resembling the aurora borealis, and twice in the form of scintillations like the sparkling phosphorescence exhibited by sea infusoria."

A similar instance is given in "Notes and Queries" of Aug. 25, page 158, under the heading of "The Nimbus." G. M.

GINGER-BEER PLANT.

[931]—In reply to Mr. F. H. Perry's query, the following information from my own observation may prove useful. The fungus he mentions is precisely similar to yeast in its action on a solution of sugar and water. The process of making "ginger-beer" may be carried on very well without the "ginger," but if the sweet solution is left too long it becomes vinegar.

Mr. Perry has, I think, been slightly misinformed concerning the nature of the so-called "ginger-beer plant." It can only live and propagate in a saccharine fluid. F. W. HALFPENNY.

COFFEE.

[932]—Would you be kind enough to ask Mr. M. Williams to give a receipt for mixing or flavouring coffee with burnt sugar, as lately described by him in his papers on "Scientific Cookery" in KNOWLEDGE?

The papers are very interesting, and having long wished to get a hint as to obtaining coffee *at home* as we get it at Gatti's restaurant, I felt disappointed that the paper in question did not give a fuller account of it, viz., of quantities and proportions required of each for mixing. If Mr. Williams would oblige with these particulars, no doubt they would be very acceptable to many other readers of KNOWLEDGE. W. G. MORTIMER.

OPTICAL PHENOMENON.

[933]—The following account of a phenomenon which came under the notice of a friend and myself the other day on one of the Cumberland mountains, may be of interest to the readers of KNOWLEDGE, as it is, I believe, of rather rare occurrence.

The mountain in question was Great Gable, one of the highest in the Lake district. We ascended it on Aug. 23 last, being on the summit between 6 and 7 p.m. The day had been very hot and fine, and the light evening clouds were floating on the tops and sides of Great Gable and the surrounding heights. One of these clouds was just passing off when we suddenly saw our shadows (or reflections) on the receding mist, with a double rainbow round both. They gave us the impression of being perhaps 100 to 200 yards away, and 10 or 15 feet in height. The rainbow was of small radius and very bright.

This appearance lasted about two minutes, as far as I can judge, coming on for a short time a minute or two afterwards. The clouds were moving in a direction from the sun, and we were, of course, in a line with the sun and our spectres. The outline of the figures was very sharp and distinct, and answered to our movements. G. G.

LETTERS RECEIVED AND SHORT ANSWERS.

MR. H. PHILLIPS.—The paragraph was taken from a highly-respected contemporary. The fact of the praise bestowed on the lamp being inserted demonstrates the absence of an inimical spirit. In fact, you can rest assured that the reverse is actually the case. We insert a correction.—C. T. PARSONS. You do not mention your telescope's size: a good deal depends on that.—D. E. SAMUEL. There are many ways of showing, or seeming to show, by algebra, that $1=2$. They mostly depend on the property that once nothing is equal to twice nothing. Thus, let $a=b$; then $a^2=b^2$, and $a^2-b^2=0=a-b$. Dividing by $a-b$ we have $a+b=1$. Now put $a=b=1$. Then our result is that $2=1$: which is absurd. Hence something in our process must be absurd. The place is soon found. We had $a^2-b^2=a-b$: that is, $(a+b)(a-b)=1(a-b)$. When $a=b$, $a-b=0$; so that this equation means that $2\times 0=1\times 0$, which is true enough. But dividing each side by 0 and making $2=1$, is manifestly an absurd process, leading to an absurd result. One might as well proceed thus:—A million times nothing equals twenty times nothing; therefore a million is equal to twenty.—T. J. BEARDWELL. Have you not made a slight mistake in your first problem? If the death rate is 21 per 1,000, and the births 25·0645 per 1,000, the *increase* per cent. is ·40645, not 2·50645 as you make it. Getting the population to double in 28 years would be a rather serious matter. Your formula is approximately true.—THOS. H. D. Evening time. The moon map referred to illustrated the first of F.R.A.S.'s papers on the Moon, in the beginning of Vol. 3. Have not the volume by me to refer to.—L. C. C. I could not let the author of articles "How to Get Strong" give advice under the circumstances. The case is one for most careful medical advice.—R. DONALD. (1) Such lightning indicates usually the progress of a distant thunderstorm. Not seen in day because daylight hides it. (2) Minnows grow but (3) not into trout.—CHAS. WOOD. Perhaps some correspondent knows of a "black sympathetic ink, to act as the green one produced by dilute muriate of cobalt,—viz. to be invisible when applied on paper and by heat to be produced, and as it cools to vanish again."—H. T. B. See fortnightly "Face of Sky" in our columns.—D. KING. Railway accident put my work back so that the subject has not been resumed, but it will be next week.—SEVERAL CORRESPONDENTS point out that the quotation at the head of the last instalment of Mr. Kimber's account of anemones is incorrect. The alteration of the order of the lines was probably intentional; as suiting the application of the lines best: "fragrance" for "sweetness," is a frequent mistake. The lines escaped my attention.—J. F. ROUNTHWAITE. I should certainly much like to visit Manitoba, when I return to America (1884, not 1885, I think); and you may be assured it would add greatly to my pleasure to meet an old Lady Somerset captain.—W. W. T. A good lunar chart (Mr. Webb's) appears in "Webb's Celestial Objects for Common Telescopes" and in my book on the Moon.—UNCERTAIN. So am I. At least about the use of the words Natural and Supernatural. But I am certain you ought not to swear when you hear them. To answer your questions we ought to know much more than we do, or than we are ever likely to do.

THE PILSEN JOEL AND GENERAL ELECTRIC LIGHT COMPANY (LIMITED).—A petition presented last month for winding up this Company was dismissed with costs. The petition was erroneously said to be presented by the Company, who, however, opposed it, and, as we see above, successfully.

Our Mathematical Column.

EASY LESSONS IN GEOMETRICAL PROBLEMS.

By Richard A. Proctor.

(*Continued from page* 127.)

SUCH problems as I mentioned in my last, usually belong to a more advanced stage of study than that for which these simple papers are intended. They also often require the use of the Sixth Book. It will suffice here to consider a few of the simplest cases.

Suppose we have such a problem as this given:—

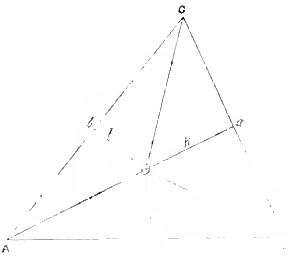


Fig. 34.

The sides of the triangle A B C (Fig. 34) *are bisected in the points* a, b, c, *and the three straight lines* a k, b l, *and* c m *are drawn at right angles to* B C, A C, *and* A B *respectively, show that these three straight lines,* a k, b l, *and* c m, *pass through a point.*

Here the student might at once refer to the Fourth Book, and find a proof in the circumstance that *a k* and *b l* have there been shown to meet at the centre of the circle through the points A, B, C. So also by the same book do the lines *a k* and *c m* meet at the centre of the circle through the points A, B, C. Now there is but one circle passing through these points; for if there were two, two circles would intersect in three points, which is impossible. Hence *a k*, *b l*, and *c m* pass through the same point.

But although this proof is sound enough, it is not independent, as a proof of this sort should be. Yet an actual and sufficient proof will run closely, as might be expected, in the lines followed in Book IV.

It is hardly necessary to say that the proof must be indirect. We can show, as in Book IV., that if *a k* and *b l* meet in O, the lines O A, O B, and O C are all equal. Then since A O = O B, a line from O perpendicular to A B must bisect A B, in other words, must pass through *c*, and coincide with *c m*. Hence if we wished to put the proof in Euclidean form, we might begin by saying,—If possible let *c m* not pass through the point O in which *a k* and *b l* intersect, but have some other position as *c m o*. Then after proving that A O = O B, we could show that O *c* is at right angles to A B. But *c m o* is at right angles to A B, wherefore from the same point *c*, there can be drawn two straight lines, at right angles to A B and on the same side of it,—which is impossible, since all right angles are equal. Therefore the line through *c* at right angles to A B cannot lie otherwise than through O.

In a similar way we can deal with the problem

If the three angles of the triangle A B C (*Fig.* 35), *be bisected by the lines* A *a*, B *b*, *and* C *c these straight lines will all pass through one point.*

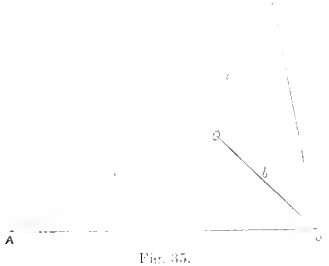


Fig. 35.

But now suppose we have this problem.—

From the angles A, B, *and* C, *of the triangle*, A B C, *Fig.* 36, *lines are drawn at right angles to* B C, C A, *and* A B *respectively. These three straight lines shall all pass through one point.*

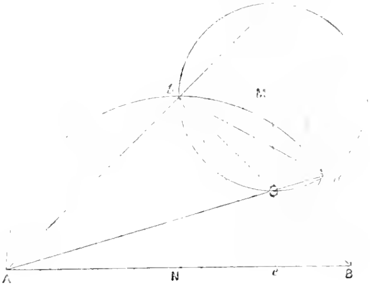


Fig. 36.

Here again the indirect method must be employed. We may draw A *a*, B *b*, at right angles to B C, C A respectively, and intersecting in O; then if we can prove that C O (produced if necessary) is at right angles to A B, what is required is done.

We have in this case the angles at *b* and *a* right angles; and it is nearly always well to try in such cases whether any good comes from noting that the angle in a semicircle is a right angle. This at once shows that a circle on O C as diameter will pass through *b a*; as will also a circle on A B as diameter. Suppose these circles drawn; or if any difficulty arises from the effort to *conceive* them as drawn, draw them in, as in the figure.

Also it will obviously be convenient to draw in the lines *a b*, *b c*, *c a*.

We have now to show that C O *c* is at right angles to A B. If this be so, the angles *c* C A and *c* A C together make up a right angle, or are complementary to each other. Of these the angle *c* A C is a known angle; so that if we look for an angle *known* to be complementary to *c* A C, we may be able to prove that so also is *c* C A. Now the angle A B *b* is complementary to *c* A C by the construction. Can we show that ∠ A B *b* = ∠ *c* C A? We must try our circles. We see that ∠ A B *b* = ∠ *b a* A on the same segment A *b*; and we see that ∠ *b a* A or *b a* O = ∠ *b* C O on the same segment *b* O. This clearly serves our purpose. For we have

∠ *b* C O = ∠ *b a* O = ∠ *b* B A = compt. of C A B

wherefore angle C *c* A is a right angle.

(*To be continued.*)

Our Whist Column.

By "Five of Clubs."

WHIST QUESTIONS.

Returning Partner's Suit.—"It hath been given out," "usually return your partner's lead, unless you have a good suit of your own." What am I to understand by a "*good suit*" to return? Suits that are considered good to lead from a hand next to the dealer are not always good suits to commence with, after having won your partner's trick. Can suits be called good that require more than two leads coming from a third hand to establish?

Muff.

[Cavendish says, return only if you have a "very good suit." For my own part, I attach so much importance to knowing early where my partner's strength lies, that I should say to him, Show your own suit if it is anything above medium strength, besides of course being long. Five of Clubs.

Long Weak Suits.—Is there any use trying to establish a suit of Five, headed by a Ten, with three or four small trumps in the same hand? The greater number of gentlemen I have had for partners during the past twelve months have always led from their long suit, and what is most extraordinary, none of them have played the game less than "forty years." Muff.

There can be no doubt they are right in so leading. The object

is not so much to establish the long suit, as to play a safe defensive game. Any other lead would be unsafe.—Five of Clubs.]

Signalling for Trumps.—(In reply to "Muff"), this is playing an unnecessarily high card,—as a seven first round, five second round.

*** Most of the back numbers of Knowledge in which Whist principles were explained can be obtained by applying to the Office in Great Queen-street.

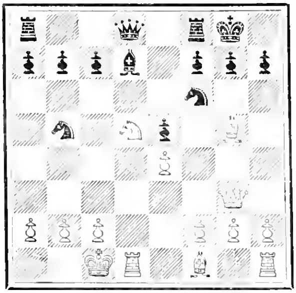
Our Chess Column.

By Mephisto.

POSITION IN A GAME BETWEEN STEINITZ AND AN AMATEUR.

Amateur.

Black.



White.

Steinitz.

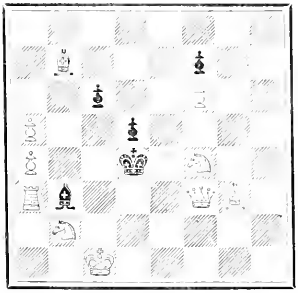
It was Black to move, and the game ended in the following pretty manner:—

	Kt takes P	B takes Kt	B takes B
B takes Q	Kt takes Q	R takes P (ch)	K takes R
Kt to K7 (ch)	K to R sq.	R to R sq. mate.	
RP takes Kt	QR takes B		

PROBLEM No. 97.

By C. Planck.

Black.



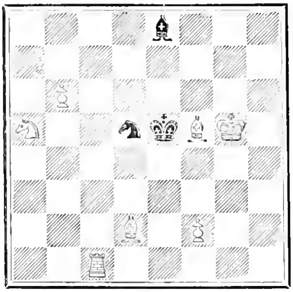
White.

White to play and mate in two moves.

PROBLEM No. 98.

By J. C. S.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Problem No. 94, by E. N. Frankenstein, p. 144.

1. Kt to Q3 (ch)	R takes R	4. Q to Kt2 (ch)	R takes Q
2. Q to Kt8 (ch)	Kt to K3	5. Kt to B4 (ch)	Kt tks Kt (ch)
3. B to R2 (ch)	R takes B	Mate.	

No. 95, by J. C. S., p. 114.

1. R to K8	Q takes R		Q to K7 (ch)
2. Kt to B6 (ch)	K to B5	R takes Q (ch)	K to B4
3. Q takes P (ch)	mate.	Q to B8 (ch) mate.	

Ending, p. 114.

1.	Q to K8 (ch)
2. K to R2	B takes P (best)
3. R takes B	R takes RP (ch)
4. K or P takes R	Q mates accordingly.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Stettin.—Solutions correct; in the ending, 2. B takes P is the correct move.

Walter Waring.—Problem received with thanks.

W.—If R to Q4, there is no dual. Solutions of 93, 94, 95, 96, and End Game correct.

G. W.—Solutions of 93, 94, and 95 correct. In the Ending you will see that 2. B takes P is more forcible.

R. Sargeant.—The Endeavour, Vassal-road, Brixton; or the Surrey Chess Association, Hon. Sec., L. P. Rees, Annandale, Anerley.

Correct Solutions Received.—Problem No. 95, Ipswich. Problem No. 96, Stanley B. Baxter, Clarence, H. A. D., Berrow, H. A. L. S., Purssell's, Cornhill.

Contents of No. 97.

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CONTENTS OF NO. 99.

OUR BOYS AT SCHOOL.

By RICHARD A. PROCTOR.

OUR youngsters are returning to their schools, where they are to be taught, besides those subjects which appear in school prospectuses, &c., many things which are not so generally mentioned. A lad may be under an Arnold or a Temple, and learn either directly or indirectly from the example and precept of his masters, to be manly and honest, generous, truthful, and brave. If his own nature unfortunately does not predispose him to good, he yet finds himself surrounded by an atmosphere of honesty and generosity, and breathing it is purified and strengthened. But all our boys are not so fortunate. They may be under head-masters who are weak or worse, who let the masters with whom the boys come more into contact be cruel and vindictive, mean, unfair, and false. Men speak of schools often as if their boys were not likely to be injured in character by weak or bad masters. A generous manly boy may escape the evil influences, direct and indirect, which such masters (whether headmasters or not) necessarily exert. But he has to breathe an uncongenial atmosphere. For, where masters are dishonest, a dishonest tone soon begins to prevail among the boys. Honesty is at a discount in such places; dishonesty pays: it is not in human nature, at least in boys' nature that among boys so placed the prevalent tone should not ere long become dishonest.

Fathers should talk to their boys over such matters, not to listen to mere faultfinding, but to find in converse with them what sort of tone prevails among their fellows. Of course with many boys such a course fails. But an honest manly boy, who regards his father as a friend not as "the governor," will very soon show, more clearly than he himself perhaps imagines, the nature of his school surroundings. One does not find that a boy worth anything objects to strict if honest discipline. I know that my own boys talk with enthusiasm of the strictest of the schools at which they have been placed. Go on to talk with them of their school life there, and you presently find that the manly tone of the masters was reflected among the boys. Lying and quibbling, cruelty and treachery took no root in a soil so unsuited to them. A boy that can talk of even punishment as "fair," and of his schoolmates as "good fellows," gives the highest possible praise to the masters of his school, and specially to the headmaster from whom as a rule the rest take their tone. If you send a boy who has been in such a school to one where vindictive ill-tempered and dishonest masters are allowed their own way, where boys are taught by example to give way to their passions, to be treacherous, cruel, and mean, you will very soon learn from him (if you are sensible enough to take interest in his talk of school life) the disgust with which he notes the difference. It is singular, too, how along with falsehood and meanness, impurity and profanity prevail where the tone among the masters is mean or false, where the better sort are outnumbered by the worse and too weak to make a manlier tone prevail. Boys who have been at such a school as I have described above, speak with as much contempt of swearing and foul language, as of sneaking or lying: but all these faults flourish as in a kindred soil, where masters are vindictive and dishonest. This too may sometimes be seen even at schools where *externally* a specially religious tone prevails.

Unfortunately the masters in our schools are not tested or examined at all as to their fitness for the most important part of their work. We know that masters set to teach mathematics, classics, modern languages, and so forth, have a certain degree of familiarity with these subjects; for they have passed certain examinations in them. But we have no means of knowing beforehand that a master who may have chief or sole charge of our boys at school has learned to control his temper as well as to construe Greek and Latin, to teach honesty by his example as effectively as he may be able to deal with mathematical examples on the blackboard, and to be fair and just as well as to be a ready speaker in French and German. Schoolboys are often full of tricks, but chiefly when their masters set them the example. Parents should if possible learn what is the tone among the boys at a school before they send their boys there. Though there can be no public examinations to test this, inquiry among the boys will often disclose a good deal. But if previous inquiry has not been possible, friendly talk with sons about their school life will soon show any one who understands boys' ways the real position of affairs. If there are many "mean fellows" among the boys, fellows who let others be punished for *their* offences, who cringe when they are not bullying and bully when they are not cringing, be sure there is something wrong among the masters. Such evidence is far better than actual complaints of unfairness on the masters' part,—for boys, like men, may complain without cause. But among a given number of boys there will always be a large proportion whose characters take their tone from the masters': they will be among the good fellows if the masters help them that way; but they will sink into the ranks of the bad fellows, (sneaks, bullies, and cowards) if the masters are of that kind.

THE SUN IN A THREE-INCH TELESCOPE.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

SO far our observations have been all made by night; it now only remains to show what may be done with a three-inch telescope while the sun is above the horizon. Naturally the ruler of our planetary system, our great centre of light and heat, the Sun himself, is the first object

which will invite our attention, and to which our instrument will be directed. Let us see what we may expect to view upon his surface. But here, at the outset, a caution is necessary. On no account whatever must the observer attempt to look at the sun under the same instrumental conditions as he has been viewing the stars. To try to do so without either the interposition of a dark-coloured eye-glass, or the employment of a device to be immediately explained, is almost certain to involve permanent blindness altogether. Sir William Herschel lost an eye in such an attempt; an attempt against which we earnestly warn the student. As a matter of practice, however, opticians send out each astronomical or Huyghenian eye-piece with a dark-glass cap, which must be screwed on whenever the sun is to be looked at directly through the telescope. Should the purchaser of an instrument have his choice of colour in these eye-caps we would recommend very dark green or blue, or else what is known as "London smoke," as the most agreeable tints for use. Red glasses are less liable to crack with the sun's heat, but they are by no means so pleasant to look through. Whatever colour, however, the observer selects, let him take care that it is dark enough; and as dark glasses are, as we have hinted, liable to crack with the sun's heat, means must be taken to diminish that heat as much as possible. This will involve, though, one of two things, either the cutting down of the aperture of the instrument to two inches, or even less, if the observation is likely to be a protracted one; or the turning away the object-glass from the sun at short intervals, should the whole of the object-glass be employed, to give the eye-piece time to cool. There is a device which, should the possessor of a telescope choose to go to the cost of it, enables the sun to be viewed for an almost indefinite period with the whole aperture. In consists simply of a perfectly plane plate of glass placed at an angle of 45° with the axis of the telescope, so as to reflect the image formed by the objective in a direction square to the optical axis. The outside of this plate is ground, so as to destroy any secondary reflection; and, pretty obviously, a very large proportion indeed both of the sun's light and heat, passes through it. The ordinary Huyghenian eye-piece (which may now be covered with a lighter eye-shade) is still employed. Or, finally, we may view the sun without looking *through* our telescope at all; and, for getting a general idea of solar detail, the method we are about to describe is perhaps the best of all. Moreover, it enables half-a-dozen people to view the solar disc at once, if necessary. In this way of using the telescope we convert it into a kind of solar microscope or magic-lantern, and throw the sun's image on to a sheet of very fine, clean, hot-pressed cardboard, which we shift to and from the eye-piece, and move the focussing tube until a sharp and distinct image of the sun is obtained. It will be necessary to have a large sheet of pasteboard covered with black paper, through a hole in the middle of which the eye-piece comes, in order to shield the card on which the image is projected from direct sunlight. The same end would be more perfectly attained by passing the object-end of the telescope through an aperture in the shutter of a completely darkened room; but this is rather too elaborate an arrangement for the ordinary observer. Where only one person wishes to see the sun at a time the receiving disc may be fastened at the bottom of a pasteboard cone fitting over the eye-end of the telescope, and with an aperture cut in the side to look through. An arrangement of this sort is illustrated on p. 136 of the "Lessons in Rudimentary Astronomy," by the Editor of Knowledge, published by Cassell & Co. (Limited). Whichever of these ways we select to view the sun in, we shall be struck by three or four salient features of his surface. The first thing we shall note is that the limb or edge of the sun is perceptibly darker than the middle of his disc, which gradually shades off as we approach his circular outline. The effect of rotundity which this gives to his image is very striking. A little consideration will show that this must be the effect of an atmosphere surrounding what is technically called the photosphere, or light-radiating surface of the sun. The next thing that will arrest our attention—perhaps just now the first—will be the dark spots which diversify the sun's face.

Fig. 1.—Spot on Sun, Sept. 12, 1883, 11.25 a.m.

The above figure may serve as an illustration of an individual single spot, and was drawn with a power of 80, on Wednesday, September 12, at 11.25 a.m. It will be seen to consist of two well-distinguished parts, a dark interior one, known technically as the Umbra (three of these umbræ at least will be observed to be included in the penumbra in the sketch above), surrounded by a lighter fringing which is called the Penumbra. By the use of a peculiarly constructed eye-piece, and a telescope of considerable aperture, the late Mr. Dawes discovered black spots within all large umbræ, and even some small ones. If the observer knows exactly what to look for he may sometimes pick these up even with a 3-inch telescope. It will, however, be necessary to cover the diaphragm in the eye-piece with a circular disc of glazed visiting card (with the glazed side towards the field-glass) centrally perforated with a minute hole made with a fine red-hot needle. The telescope is moved until the spot occupies this exceedingly circumscribed field; and thus cut off from the surrounding glare, the nucleus may often be detected. We have so far spoken as though spots were isolated, but they perhaps most frequently appear in groups, involving the most enormous areas on the sun's surface, of the disturbances of which they are the outward and visible sign.

Our next figure represents a group of spots visible on the sun at 9.50 a.m. on June 30th of the present year, and was drawn, like every other figure illustrating this series of

Fig. 2.—Group of Spots, June 30, 9.50 a.m. (visible to the naked eye).

papers, at the telescope. As a reflecting eye-piece was used in this particular case, though, everything is turned right for left in the engraving. It will be noted how the curves of the penumbræ connected the umbræ. Micrometrical measurement made immediately after our sketch

gave the superficial area of the left-hand group as 762,940,200 square miles, and that of the right-hand one 1,074,370,000 square miles, or, in all, 1,837,310,200 square miles of the sun's surface, as involved in this stupendous disturbance alone! It could be seen with the naked eye when defended by a darkened or smoked glass. There were other spots on the sun's disc at the time. Careful study of the spots under the most favourable definitions will reveal certain striking features. The umbræ, under ordinary circumstances, seem to be black; but the student who has the opportunity of watching a partial solar eclipse, or a transit of Mercury, will at once be struck with the extreme blackness of the moon's limb or of the planet, as contrasted with the (now, by contrast) brown hue of the spots. A distinctly brown, and even orange tinge may often be seen in the images of spots projected on to a sheet of cardboard, in the manner described above. Attentive study of the penumbra will reveal a kind of fimbriated or fringed appearance in it; and it will be further noticed to be darkest at its outer edge, and seemingly to get lighter as it approaches the umbra. Returning now to the limb, or edge of the sun, which, as we have previously said, will be perceived to be notably darker than the centre of his disc, we shall find the shading diversified by curious and often rather complicated streaks of light. These are called "faculæ," and are most numerous and conspicuous about spots which are close to the limb, or where such spots are about to break out. We have sometimes traced faculæ for some considerable distance on to the brighter part of the sun's disc; but, as a rule, they are only seen near the limb. The sketch which follows represents a group of faculæ which was visible on the morning of Aug. 25, at 9 h. 40 min.:—

Fig. 3.—Faculæ on Sun's limb, Aug. 25, 1883, 9.40 a.m.

It was drawn on the paper on to which the image of the sun was projected, in the manner previously described. The fourth piece of solar detail of which we need here speak is the mottling or graining of his surface. This is best caught by shifting the telescope a little, so as to make the sun's image move about in the field. If this be done, the eye will soon receive the impression of a roughness or grain upon the sun's face, akin to that of a piece of magnified loaf-sugar. In large instruments this is seen under the best definition to consist of markings which have, not unaptly, been compared to rice grains, but its resolution into these appearances is wholly beyond our instrumental power.

Such are the leading features observable on the surface of the sun with the means at our disposal. Mutatis mutandis, we may say, as we did concerning the moon, that we are not writing a heliographical treatise; and hence, for their interpretation, must refer the reader to "The Sun," by the Editor of this Journal, or to the volume of the "International Scientific Series," bearing the same title, by Professor Young. We have simply essayed—not, we trust, wholly without success—to indicate what may be seen upon the sun in a three-inch telescope. By the aid of Browning's star spectroscope, with a very narrow slit, the spectra of prominences (those huge uprushes of hydrogen gas known as the "red flames" which are seen during a total solar eclipse) may often be detected on the sun's limb, even in a telescope of the size of that whose use is presupposed; but the mention of the fact must suffice here.

THE FISHERIES EXHIBITION.

By John Ernest Ady.

VII.

Amongst the numerous exhibits which bear upon our subject, there are perhaps few which call for more attention than those concerned with the supply of water for domestic use.

On the left-hand side of the passage leading to the aquarium gallery, a remarkable filter is being exhibited by Mr. P. A. Maignen, called the "Filtre Rapide." For simplicity in design and efficient working qualities, this filter deserves some notice in these columns, especially as a short description may bring a very useful article within easy reach of many of our readers. In Fig. 16, two sectional diagrams are given of this apparatus. The explanation under the figures will suffice to convey an idea of their structure, which shows that the filter itself consists of movable pieces, which can thus be thoroughly cleansed and replaced with very little trouble, and at a merely nominal expense; the cleansing process, moreover, need not be repeated oftener than once during the course of about three months.

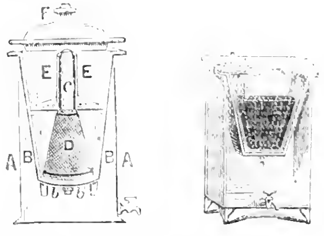


Fig. 16.—Sectional Views of Maignen's "Filtre Rapide."—A, reservoir for the filtered water; B, the filter case, which is removable; D, conical sac of asbestos cloth tied over the filtering frame, which consists of a funnel-shape perforated piece with outlet, bb', and aërating pipe, C. On the outside of the asbestos cloth a charge of powdered "carbo-calcis" is deposited, by being mixed with the first water run into the filter. This forms a layer on the cloth through which all subsequent water must pass and be purified. E, screen for protecting the filtering medium. The figure to the right-hand side is a different form of the same apparatus.

In the majority of filters now used, two types of construction have invariably been followed, both of which are

more or less open to very serious objections, either on account of their mechanical details, or because they fail after a time to "fulfil their functions" adequately. In the first form of filter just alluded to, the working portion is securely cemented down, and when it requires to be cleansed, an amount of delay and expense is occasioned which is often very disheartening to the unfortunate possessor. The second variety consists either of a solid mass of porous carbon, or other material filled in to produce a dense aggregate through which the water is made to pass. It is obvious that, in these arrangements, there is a tendency for the filters to become "foul" through the accumulation of noxious materials within their porous recesses, which then necessitates a laborious cleansing process.

It is a prevalent notion amongst those who have not paid any attention to the subject, that drinking water harbours countless strange organisms which pass collectively under the name of "animalculæ," very likely for the same reason why Rotifers, Diatoms, and Desmids were classed together with the *Infusoria* by the earlier microscopists. Doubtless this popular belief had its origin in such pictures as Fig. 17, taken from Dr. Hassall's valuable little work on "Food and its Adulterations," as well as from indiscriminate displays of a drop of stagnant water under the microscope at Sunday-school *soirées*, or other delightful heterogeneous gatherings. But, when it is known that these monstrous-looking creatures can be captured from drinking water only after diligent search and by straining oceans of the water, and that only in very ill-conditioned water do they congregate in numbers, much of the ardour and wonderment of the inquiring novice is dispelled, and he feels that he is disappointed because he does not actually swallow a few millions of them with every tumbler-full of water.

A B

Fig. 17.—A, animal and vegetable productions contained in the water of the Thames taken at Richmond. B, organic matter, living and dead, especially the Thames *Paramœcium* and husk of wheat (from Hassall).

Nevertheless, it is a patent fact that these minute forms of life do live and thrive in drinking-water, a fact attested to by Fig. 18, which is also taken from Dr. Hassall's book.* Some of these little creatures are harmless; indeed, they are even useful, in endowing the water with a certain palatable freshness through the gases which they eliminate; but others—and alas! by far the larger proportion—are highly deleterious. Take, for example, the *Paramœcia* in Figs. 17 and 18; they are the invariable concomitants of decaying vegetable matter, and are often accompanied by minuter forms, whose very names, *Bacterium*, *Bacillus*, &c., have recently been associated with the most virulent maladies which "flesh is heir to." Most of them have already been described in these pages by Mr. Slack; we therefore refer the reader to his excellent articles.†

* We are indebted to Mr. Maignen for the use of these figures.
† *Ut supra* June 1st, June 29th, and July 13th, 1883.

Fig. 17 shows, that beside living creatures, water is apt to contain foreign particles of dead matter in various stages of decay, such as the husks and straws of wheat, &c., and inorganic particles—*e.g.*, sand, &c. Whilst mostly harmless in themselves, they afford food and shelter to the more unwelcome living things. At all events, everybody will admit that, taking all these circumstances into consideration, it is desirable to free the water from them by some means, and then to try to render that water palatable. Both of these ends are met by Maignen's filter, which purifies, and at the same time aerates, the water. Although we have seen the exhibitor quaff from a glass of purified

A B

Fig. 18.—A, Water taken from Cistern. *a*, blood-red Annelids; *b*, *Brachionus polyacanthus*; *c*, *Euplotes charon*; *d*, *Paramœcia*; *e*, *Amphileptus*; *f*, *Actinophrys Sol*; *g*, *Actinophrys viridis*; *h*, *Pediastrum Boryanum*; *i*, *Closterium Lunula*; *k*, *Scenedesmus quadricauda*; *l*, *Scenedesmus acutus*; *m*, *Scenedesmus obtusus*; *n*, *Cyclotella operculata*; *o*, *Nitzchia Sigma*; *p*, *Synedra minutissima*; *r*, *Melosira varians*; *s*, Threads of slender fungus; *t*, Minute star-shaped bodies; *v*, Organic and earthy matter. Mag., *a* 12; *h* 100, the rest 200 diameters. B, Water taken from Service Pipe. *e*, *Paramœcia* (2 species); *b*, *Vorticella convallaria*; *c*, *Coleps hirtus*; *d*, *Pandorina Morum*; *e*, *Scenedesmus quadricanda*; *f*, *Navicula Amphisbœna*; *g*, *Navicula sphærophora*; *h*, *Asterionella formosa*; *i*, *Fragilaria Capuoina*; *k*, Brown active sporules; *l*, Stationary green sporules; *m*, Threads of slender fungus; *n*, Organic and earthy matter; *o*, *Anguillula fluvialis*.

sewage which had simply passed through the patent invention, yet we are inclined to advise a previous boiling of the water, to ensure the death of such things as *Bacteria*. The aerating tube, C, Fig. 16, may also be loosely plugged with cotton wool, so that stray germs can be intercepted, and if a cork be fitted into the aperture so prevent aeration, the filtered water we have found to be admirably adapted to the wants of a naturalist's laboratory, where distilled water is not always necessary.

The next series of exhibits which demands our attention is that comprised under the head *Cœlenterata*, with its two principal classes, the *Hydrozoa* and the *Actinozoa*. A *Cœlenterate* animal consists essentially of a sac-like body, the walls of which are primarily composed of two layers, an outer, *ectoderm*, and an inner, *endoderm*. There is generally a radial arrangement of parts, observable chiefly in the tentacles with which nearly all of them are provided; and, although they do not possess any marked nervous system, they are characterised by the presence of "thread cells," or peculiar urticating organs, used as weapons of offence and defence. It will be seen from this definition that they approach very nearly to some of the sponges, and their reproductive processes, both by gemmation and division, as well as in the simpler forms of sexual generation, link the two groups together still more closely.

At Stand 756, a series of microscopes, under the care of Mr. Bolton, of Birmingham, are invariably supplied with living forms of one of the simplest, and certainly most beautiful, of the *Hydrozoa*—viz., *Hydra viridis*, or the fresh-water polype. The little *Hydra* consists of a simple cylindrical green sac-like body, closed at one end, which serves to attach it at the will of the creature to some

foreign object. The other end contains a central aperture, or mouth, which leads into the simple sac-like body cavity; around the mouth a circlet of tentacles, or arm-like hollow slender process, are spread out. Careful examination with a high power of the microscope shows that the wall of the body cavity and of the tentacles, which are cœcal prolongations of that cavity, are composed of two layers of cells, constituting an *ectoderm* and an *endoderm;* and that between these there is the early indication of a third layer, or *mesoderm*, which arises from the basal extremities of the ectodermal cells. This layer is called, after its discoverer, Kleinenberg's *neuro-muscular* layer, because it is supposed that it represents a nascent form of muscular and nervous system combined.

Many very complicated forms of *Hydrozoa*, which include the peculiar plant-like sea-firs (*Sertularida*), and their strange independent reproductive members, termed medusoids, or jelly-fishes, may be seen in bottles of spirit at the extreme corner of the East Quadrant. These specimens are each worthy of a careful description, so exquisitely have they been prepared. We may state here, without fear of any contradiction, that each specimen in the collection from the Zoological Station of Naples is a masterpiece of museum mounting, and we would therefore draw the special attention of students to this section of the Exhibition.

In spite of the extreme variety of form exhibited by the *Hydrozoa*, the primitive sac-like nature of the organism, consisting of two layers, is never wholly disguised, and this fact, which was first generalised by Huxley,* has led that eminent observer to make the following statement:—

> "Thus there is a very real and genuine analogy between the adult hydrozoön and the embryonic vertebrate animal; but I need hardly say it by no means justifies the assumption that the Hydrozoa are in any sense arrested developments' of higher organisms. All that can justly be affirmed is, that the hydrozoōn travels for a certain distance along the same great highway of development as the higher animal, before it turns off to follow the road which leads to its special destination."†

* Proc. Linn. Soc., 1849.

† "Monograph of the Oceanic Hydrozoa." Ray Society's Publications. 1859.

TRICYCLES IN 1883.

SMALL WHEELS *v.* LARGE WHEELS.

By John Browning,

Chairman of the London Tricycle Club.

"SIGMA" has completely missed my point. He has evidently written under the supposition that I am advocating *theoretically* the construction of tricycles with small wheels, whereas I am showing that three or four years ago I was advocating their use theoretically, while now the most advanced and skilful manufacturers are making them, and the fastest and best riders are adopting them, and having proved my case experimentally, I have only written with the intention of hastening the inevitable revolution; but I am obliged to my friend "Sigma" for giving me the opportunity of making my views clearer on this subject. He has totally misunderstood me, and others may have done the same. He has also completely misrepresented what I have said, though this, I feel sure, he has done unwittingly.

I find "Sigma" accusing me of recommending tricycles which will travel at four or five miles an hour, and, by implication, calling me absurd for doing so. My reply is simply that I have not done so.

I find myself accused also of theorising. I have nowhere referred to theories in my articles, but only given facts, and conclusions which must follow from them.

Next I am told that it is easier to ride a machine with large wheels at seven or eight miles an hour than a machine with 36-inch wheels at the rate of four miles an hour. I reply that "Sigma" has not tried the experiment or he would not say so. *I have, and know it is not.*

"Sigma" supposes that I recommend small wheels because they are easy, though slow. I do so because, as I state, they are *easy and fast.*

The person who begins with one of the small-wheeled machines could, as he wished for more speed, have his machine geared up even to 65 inches if he pleased, at a trifling expense.

This would avoid all the rapid pedalling "Sigma" declaims against.

"Sigma" says the machine he rides has 50-inch wheels, is geared up to 60 inches, and yet weighs only 60 lbs. I reply that if it had wheels 40 inches diameter they might be geared up to 60 inches, and the weight of the machine might be reduced to about 40 lbs., and yet be equally strong and it would be faster.

"Sigma" is an exceptionally strong rider and I am a weak one, but Mr. Nixon, who is a more powerful rider even than himself, will tell him that I gave him the slip in Croydon, not long since, and that he had to ride for half an hour, at the rate of certainly more than ten miles an hour before he could catch me.

Mr. Nixon had 50-in. wheels, and I had 38-in. geared to 48-in.

Had I been riding a machine like his own, Mr. Nixon would have had no trouble in catching me in five minutes.

No one knows better than "Sigma" how much I have the interests of tricyclists at heart. Surely he may trust me *on a mechanical matter* not to mislead them.

The fact that the Coventry "Rotary," one of the fastest machines, has *two* 20-in. wheels on one side is a sufficient proof, if any were required, that small wheels will not prevent a machine from travelling quickly.

Early this year, I had the pleasure of acting as judge in the 100 miles road ride of the London Tricycle Club.

"Sigma" will not be likely to forget this, as, with a disabled hand and foot and a broken machine, the result of an accident only two days before, he won the 100 miles time medal in an exceptionally plucky manner.

The first thirty-six miles of road—from Boston to Peterborough—was so rough that it broke the front wheels of several machines. Rough roads are supposed to be unrideable by small wheels, yet Mr. Arthur Salmon was amongst the first two or three men in, *though he was riding a machine with 42-in. wheels.*

A few weeks ago, Mr. A. Salmon and myself rode 65 miles in a day together. Mr. Salmon rode his 42-inch, geared up, I believe, to 58, I rode my 38-in., geared to 48 in., we stopped about three hours for rest and refreshment. and I was home before eight o'clock in good daylight. I leave "Sigma" to imagine whether our pace was anything like four or five miles an hour.

Not a single remark was made about the smallness of our machines by drivers or others, nor has there been either before or since, and I am sure our Editor will agree that some D.G.N.F. would, if we looked awkward on them, be sure to tell us so. The L.T.C. is strong in chaff as well as riding.

Mr. Salmon is 5 ft. 10 in. at least, and finds 42-in. wheels large enough for him.

In proportion to this, as I am only 5 ft. 4 in., a machine

with 36 in., which I shall have geared up to 50 in., should be large enough for me, and I shall ride nothing larger than this after this season.

If my friendly antagonist, instead of trying to prove I am wrong—on paper (a hopeless task, though he is so able a writer that he is sure to make out an apparently good case), will use the influence he has to get the manufacturers to make him an Imperial Club, with 40-inch wheels geared to 60 inches to weigh under 45 lb. or 40 lb., if possible, and will try the machine, I am certain he will go no further with his arguments against small wheels.

In the 50 miles Road Ride, which took place last Saturday, Mr. Marriott for the first time used a tricycle which had wheels only 40 inches in diameter. These were geared up to 56 inches, that is, ran as if they were wheels 56 inches in diameter. The machine weighed only a trifle over 46 lb.

Mr. Marriott covered the distance in less time than it has been done on any previous occasion, though the road was hilly and muddy, and the wind very strong against him on returning.

In this ride Mr. Marriott really covered 54 miles in 4 hours 7 minutes, and was unavoidably detained ten minutes, so that the 54 miles were actually ridden in 3 hours 57 minutes on these small wheels.

The future of the tricycle now lies with small-wheel machines. Unfortunately, this is a matter easily misunderstood by those who have not practically experimented on the subject.

Herbert Spencer begins a wonderful series of delusive illustrations thus:—"It stands to reason that salmon will be cheaper in Aberdeen than in London"—which is the reverse of the fact.

Similarly, I would say:—It stands to reason that a large-wheeled tricycle will pass over an obstacle easier than a small one. To make this proposition true, it is necessary to add—*other things being equal.*

But other things are *not* equal in our case, as by using small wheels we get a much smaller and lighter machine, and one that will pass more easily over obstructions than a heavier machine on larger wheels.

"Sigma" altogether ignores the support my views have received from the following authorities:—

Mr. Marriott, one of the first manufacturers and the finest rider of the day, whose letter I have forwarded to the Editor.

Messrs. Nixon and A. Salmon, the two best riders of the London Tricycle Club, and Mr. Percy Letchfour, one of the fastest riders of the Finchley Tricycle Club, *all racing men.* Also Messrs. Salmon, Howard, and Grace.

If, instead of instancing an aged clergyman, with but slender experience, he can quote the names of some well-known riders, who, having tried the new small-wheeled machines, have gone back to large wheels, then he will have gone some way towards proving that I may be wrong.

On one point I can excuse "Sigma" for misunderstanding me; that is, where I intimated that I pretty well agreed with the rough estimate that about one mile in each ten of road will be found unrideable. I did not wish to occupy space by explaining that, by unrideable I did not mean that they cannot actually be ridden, but that *it does not pay to ride them.*

A hill which is just rideable will require the expenditure of more than four times the power to ride it than it will to walk it.

Why do engineers make tunnels for locomotives to run as nearly on a level as possible? Simply because it is a great disadvantage to have to mount steep inclines on wheels.

THE BIRTH AND GROWTH OF MYTH.

By EDWARD CLODD.

XVI.

As we have seen, the totem is the clan-name indicating descent from a common ancestor. It is also the clan-symbol, badge, or crest. Where the tribes among whom it is found are still in the picture-writing stage, *i.e.*, when the idea is expressed by a portrait of the thing itself instead of by some sound-sign—a stage in writing corresponding to the primitive stage in language, when words were imitative—there we find the rude hieroglyphic of the totem a means of intercourse between different tribes, as well as with whites. A striking example of this is given in the sketch (Fig. 1), which is a copy of a petition sent by some Western Indian tribes to the United States Congress for the right to fish in certain small lakes near Lake Superior.

The bird represents the leading clan, the crane; then follow three martens, as totems of three tribes; then the bear, the man-fish, and the cat-fish, also totems. From the eye and heart of each of the animals runs a line connecting them with the eye and heart of the crane, to show that they are all of one mind, and the eye of the crane has also a line connecting it with the lakes on which the tribes have their eyes, and another line running towards Congress.

In the barbaric custom of painting or carving the totem on oars, on the bows and sides of canoes, on weapons, on pillars in the front of houses, and on the houses themselves; in tattooing it on various parts of the body (in the latter case, in some instances, together with pictures of exploits; so that the man carries on his person an illustrated history of his own life) we have the remote and forgotten origin of heraldic emblems. The symbols of civilised nations, as, *e.g.*, the Imperial eagle, which so many states of ancient and modern renown have chosen; the crests of families of rank, with their fabulous monsters, as the cherub, the Greek *gryps*, surviving in the griffin, the dragon, the unicorn, which, born of rude fancy or terrified imagination, are now carved on the entrance-gates to the houses of the great; the armorial bearings on carriages; the crest engraven on ring or embossed on writing-paper, these are the lineal descendants of the totem; and the Indians, who could see no difference between their system of manitous and those of the white people, with their spread-eagle or their lion-rampant, made a shrewd guess that would not occur to many a *parvenu* applying at the Heralds' College for a crest. The continuity is traceable in the custom of the Mexicans and other civilised nations of painting the totemic animals on their banners, flags, crests, and other insignia; and it would seem that we have in the totem the key to the mystery of those huge animal-shaped mounds which abound on the North American continent.

The arbitrary selection in the "ages of chivalry" of such arms as pleased the knightly fancy, or ministered to its pride, or, as was often the case, resembled the name in sound, together with the ignorance then and till recently existing as to the origin of crests, and also the discredit into which a seemingly meaningless vanity had fallen, have made it difficult to trace the survival of the totem in the crests even of that numerous company of the Upper Ten who claim descent from warriors who came over with the Conqueror. But there is no doubt that an inquiry conducted on the lines suggested above, and not led into bypaths by false analogies, would yield matter of interest and value. It would add to the evidence of that common semi-civilised stage out of which we have risen. Such names as the Horsings, the Wylfings, the Derings, the Ravens, the

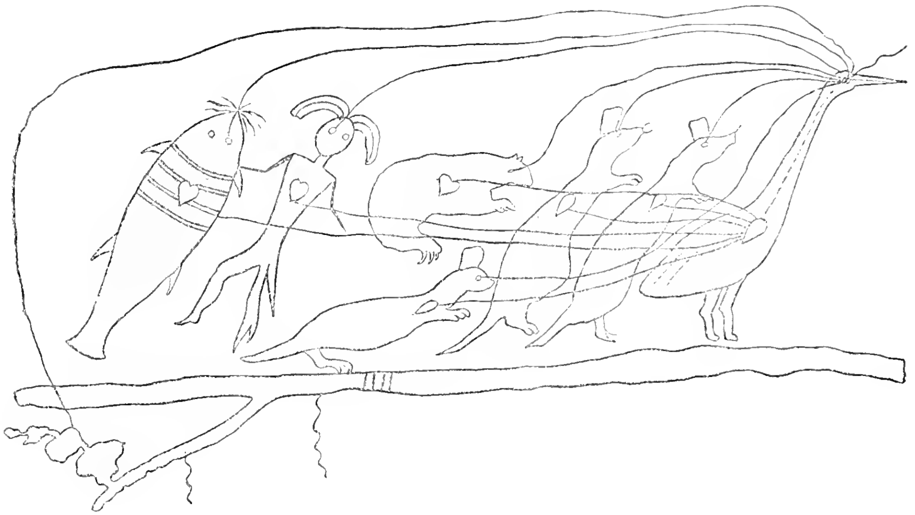


Fig. 1.

Griffins, may hold within themselves traces of the totem name of the horse, wolf, deer, raven, and that "animal fantasticall," the griffin. In Scotland we find the clan Chattan, or the wild cat; in Ireland "the men of Osory were called by a name signifying the wild red deer." On the other hand such names may have been given merely as nicknames (*i.e.*, ekename or the *added* name, from *eke*, "also," or "to augment"), suggested by the physical or mental likeness to the thing after which they are called.

But it is time to turn to the religious significance of the totem, as shown among races worshipping the animal which is their supposed ancestor.

At first glance this seems strong argument in support of Mr. Herbert Spencer's theory that all forms of religion (and all myth) have their origin in ancestor worship. The mysterious power of stimulation, of excitation to frenzy, or of healing and soothing, or of poisoning, which certain plants possess, has been attributed to indwelling spirits, which, as Mr. Spencer contends, are regarded as human and ancestral. Very many illustrations of this occur, as, *e.g.*, the worship of the Soma plant, and its promotion as a deity among the Aryans; the use of tobacco in religious ceremonies among the tribes of both Americas; whilst now and again we find plants as totems. The Pueblos have a tribe called the tobacco-plant, and also one called the red grass. One of the Peruvian Incas was called after the native name of the tobacco-plant; and among the Ojibways the buffalo grass was carried as a charm, and its god said to cause madness. Its manlike character is seen in the accompanying picture (Fig. 2.)

The worship of animals is on the like theory explained as due to the giving of a nick-name of some beast or bird to a remote ancestor, the belief arising in course of time that such animal was the actual progenitor, hence its worship. We call a man a bear, a pig, or a vampire, in symbolic phrase, and the figure of speech remains a figure of speech with us. But the savage loses the metaphor and it crystallises into hard matter-of-fact. So the traditions have grown, and Black Eagle, Strong Buffalo, Big Owl, Tortoise, &c., take the shape of the actual forefathers of the tribe having their name and crest. According to the same theory, the adoration of sun, moon, and mountains, &c., is due to a like source. Some famous chief was called the

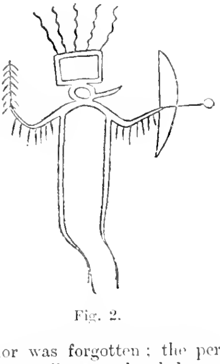


Fig. 2.

Sun; the metaphor was forgotten; the personal and concrete, as the more easily apprehended, remained; hence, worship of the powers of nature "is a form of ancestor-worship, which has lost in a still greater degree the character of the original."*

The objection raised in former papers of this series to the extreme applicaion of the solar theory applies, so it seems to me, with equal force to Mr. Spencer's limitation of the origin of myth and religion to one source. Having cleared Scylla, we must not dash against Charybdis. Religion has its origin neither in fear of ghosts, as Mr. Spencer's theory assumes nor in a perception of the Infinite inherent in man, as Professor Max Müller holds. Rather does it lie in man's

* "Principles of Sociology," p. 413.

sense of vague wonder in the presence of powers whose force he cannot measure, and his expressions towards which are manifold. There is underlying unity, but there are, to quote St. Paul, "diversities of operation." There is just that surface unlikeness which one might expect from the different physical conditions and their resulting variety of subtle influences surrounding various races; influences shaping for them their gods, their upper and nether worlds; influences of climate and soil which made the hell of volcanic countries an abyss of sulphurous, stifling smoke and everlasting fire, and the hell of cold climates a place of deathly frost; which gave to the giant-gods of northern zones their rugged awfulness, and to the goddesses of the sunny south their soft and stately grace. The theory of ancestor-worship as the basis of every form of religion does not allow sufficient play for the vagaries in which the same thing will be dressed by the barbaric fear and fancy, nor for the imagination as a creative force in the primitive mind even at that lowest at which we know it. And, of course, beyond that lowest lies a lower never to be fathomed. We are apt to talk of primitive man as if his representatives were with us in the black fellows who are at the bottom of the scale, forgetting that during unnumbered ages he was a brute in everything but the capacity by which at last the ape and tiger were subdued within him. Of the beginnings of his *thought* we can know nothing, but the fantastic forms in which it is first manifest compel us to regard him as a being whose feelings were uncurbed by reason. That ancestor-worship is one mode among others of man's attitude towards the awe-begetting, mystery-inspiring universe, none can deny. That his earliest temples, as defined sacred spots, were tombs; that he prayed to his dead dear ones, or his dead feared ones, as the case might be, is admitted. From its strong personal character, ancestor-worship was, without doubt, one of the earliest expressions of man's attitude before the world which his fancy filled with spirits. It flourishes among barbarous races to-day; it was the prominent feature of the old Aryan religion; it has entered into Christian practice in the worship of saints, and perhaps the only feature of religion which the modern Frenchman has retained is the *culte des morts*. That it was a part of the belief of the Emperor Napoleon III. the following extract from his will shows:—"We must remember that those we love look down upon us from heaven and protect us. It is the soul of my great Uncle which has always guided and supported me. Thus will it be with my son also if he proves worthy of his name."

But the worship of ancestors is not primal. The remarks in my former paper on the late recognition of kinship by savages, among whom some rude form of religion existed, tell against it as the earliest mode of worship. Moreover, nature is bigger than man, and this he was not slow to feel. Even if it be conceded that sun-myth and sun-worship once arose through the nick-naming of an ancestor as the Sun, we must take into account the force of that imagination which enabled the unconscious myth-maker, or creed-maker, to credit the moving orbs of heaven with personal life and will. The faculty which could do that might well express itself in awe-struck forms without intruding the ancestral ghost. Further, the records of the classic religions, themselves preserving many traces of a primitive nature-worship, point to an adoration of the greatness and bounty, as well as to a sense of the maleficent and fateful, in earth and heaven which seem prior to the more concrete worship of forefathers and chieftains.

If for the worship of these last we substitute a general worship of spirits, there seems little left on which to differ. As aid to the explanation of the belief in animal ancestors and their subsequent deification and worship, as of the lion, the bull, the serpent, &c., we have always present in the barbaric mind the tendency to credit living things, and indeed lifeless, but moving ones, with a passion, a will, and a power to help or harm immeasurably greater than man's. This is part and parcel of that belief in spirits everywhere, which is the key to savage philosophy, and the growth of which is fostered by such secondary causes as the worship of ancestors.

SUN-VIEWS OF GREAT BRITAIN.

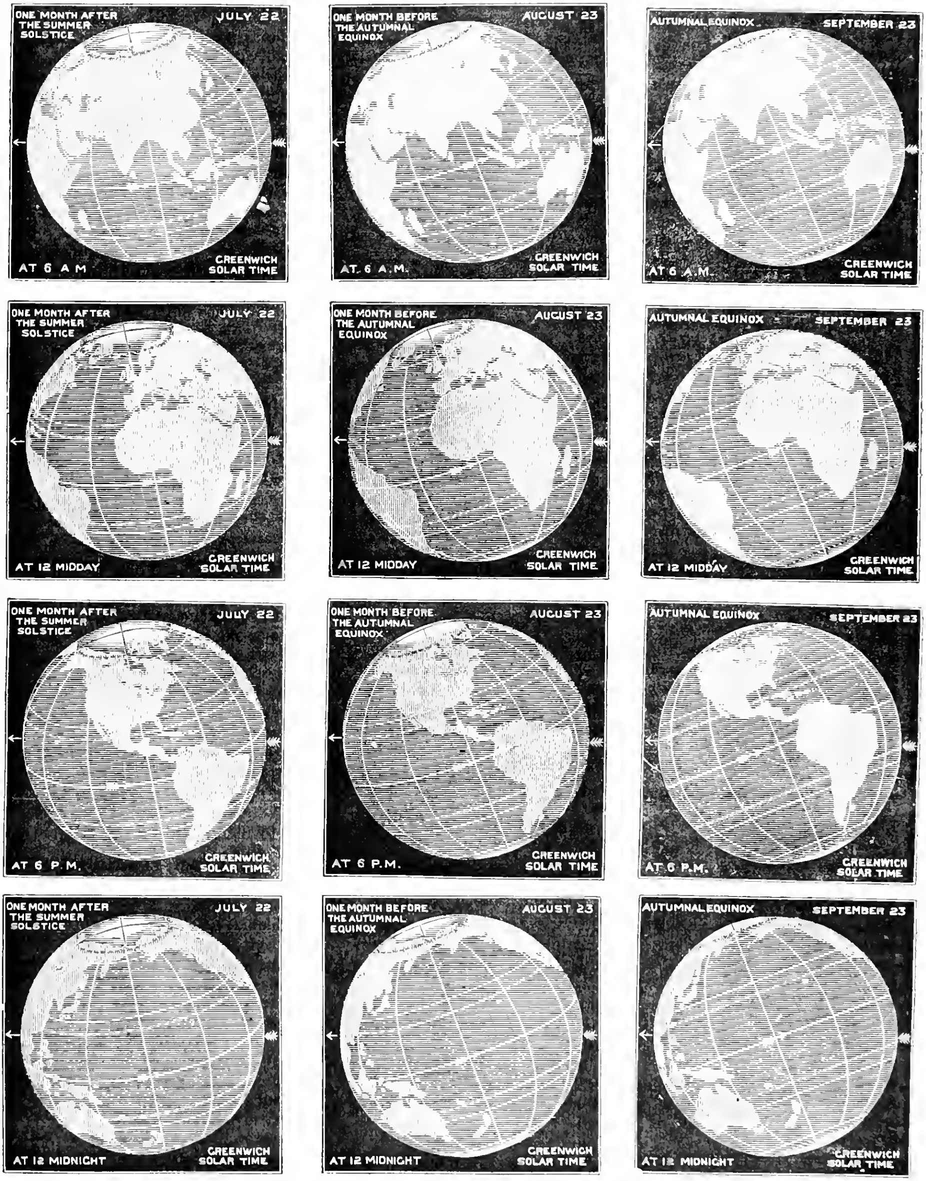
THE aspect of Great Britain, France, Denmark, &c., as supposed to be seen from the sun at noon (Greenwich time), at this season of the year is shown in Fig. 2, Fig. 1 showing the aspect those regions had at noon in midsummer, and Fig. 3 showing the aspect they will have at noon in midwinter.

Fig. 1. At noon, Midsummer (Greenwich time).

Fig. 2. At noon, in Spring or Autumn (Greenwich time).

Fig. 3. At noon, Midwinter (Greenwich time).

One Month after Summer Solstice. One Month before Autumnal Equinox. At the Autumnal Equinox.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week the Sun Views for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight, Greenwich solar time, at the autumnal equinox. For comparison, the Sun Views for July and August are repeated.

NOTES ON PUNCTUATION.

By Richard A. Proctor.

The *Brighton Herald* contends zealously for the rights of the humble comma, though now somewhat changing the figure by speaking of the comma as a humble but willing soldier, always ready to do its duty. The *Herald* is with us so far as the appearance of the comma before "who" or "which," when not wanted there, is concerned. A recent example has illustrated the mischievous effect of such excess of zeal on the part of the humble but willing soldier. Writing of "the Brighton Liberals who met yesterday, &c.," the *Herald* found a Conservative contemporary had altered the meaning of the words by pressing a humble soldier in before the "who."

But the *Herald* maintains its position about the use of the comma on either side of "therefore," in such a sentence as, "He called for help; and therefore I struck him," which the *Herald* writer would punctuate, "He called for help; and, therefore, I struck him." He reasons thus:—

> Our position, and we think it a strong one, is that the "therefore" is a parenthetical introduction, quite independent of the "and," which, indeed, it in no way qualifies. The "and" is the conjunction," the "therefore" an explanatory allusion, not to the "and" but to the sentence preceding it. Mr Proctor thinks that if the "and" were omitted, no one would think of adding a comma after "therefore." Possibly not, though even that is an open issue; but we must point out that the omission of the "and" implies a re-construction of the sentence, and, therefore, that what would hold good in one case need not necessarily be held to be bad because it does not hold good in the other. The same remark will apply to Mr Proctor's other illustrations. After reading the article very carefully, we cannot adopt Mr Proctor's contention that "and, therefore," is "simply monstrous," and we are afraid that we shall persist in the "absurdity which no good writer ever allows to remain, if he can possibly help it." How many well-intentioned gentlemen who imagine themselves to be "good writers" will this sentence shock!

[I am doubtful whether "this sentence" means the quoted sentence of mine or the whole sentence: if the former I can only say that I had no wish to shock "well-intentioned gentlemen who imagine themselves good writers."]

Now though the question thus raised is not a very important one it illustrates well the general principles involved in punctuation. Here is a writer who, after careful study of the matter, arrives at the conclusion that certain commas are necessary or at least desirable soldiers in a simple sentence, while here (at his desk perusing these words) is another who considers them simply monstrous, or at least described them so when he supposed that no practised writer would stand up for them, after a little consideration of what appeared to him their inherent absurdity. Of course the word "monstrous" is withdrawn now, out of courtesy. But my objections remain.

Suppose for a moment that we regard the word "therefore" as a parenthetical introduction, would that justify its enclosure between commas? Not at all; for "commas" are entirely different from parentheses in their meaning and effect. The best proof of this is that there may be three or five commas in a correctly punctuated sentence, whereas parentheses always come in pairs. Thus consider the sentence "He insulted me; and, therefore, I struck him, but not violently." Here there are three commas, the two first put in according to the *Herald's* plan and the compositor's constant rule, the third manifestly necessary. Where now is the parenthetical introduction? Is it the word "therefore," or is it the statement "I struck him"? If commas and parentheses were interchangeable it might as well be one as the other; in other words, the sentence, judged by the *Herald's* way of treating commas, bears more meanings than one.

But again, (which compositors nearly always change into But, again,) suppose we write "and (therefore)," or "and, therefore," agreeing to regard the commas as parentheses, what have we done by thus carefully nursing our parenthetical introduction? Have we helped the sense? Have we made it clearer than it was before that the word "therefore" relates to the preceding sentence. On the contrary, so far as we have done anything besides cumbering the sentence, we have made it appear that the word "therefore" relates specially to the "and"; for a parenthetical introduction is always referred to what immediately precedes, or belongs specially to the place where it is brought in. (In this indeed consists the whole art of using parentheses properly). Apart from the logical pressure thus brought to bear on the unfortunate little "and," consider the pressure which falls on it from the mere effect of pausing before and after the word "therefore." Read aloud successively,—

> He called for help; and therefore I went to him,
> He called for help; and, therefore, I went to him,

making in each case a proper pause for each stop, and the absurdity of the commas attending on therefore becomes at once apparent. Try these sentences again,—

> He insulted me; and therefore I went away,
> He insulted me; and, therefore, I went away,
> He insulted me; and therefore (not wishing to make a scene) I went away,
> He insulted me; and, therefore, (not wishing to make a scene) I went away.

The last two show the proper use of parentheses. In the former (of these) commas might have been used in accordance with the custom which allows them sometimes to replace parentheses; but parentheses are better, since they interrupt the sense less.

Some who object to parentheses altogether, would prefer

> He insulted me; and therefore I went away: for I did not wish to make a scene.

But there can be no doubt that the use of parentheses in such cases as these diminishes what may be called the mental friction in reading.

In connection with the parenthetical value of the comma, examine the first sentence in the passage quoted above from the *Brighton Herald*. It is a curiosity in its way.

The fact is, however, that apart from all questions of logic, punctuation, and so forth, the spirit of our language, I may say the spirit of language, rejects altogether the idea that such words as *so*, *yet*, *thus*, *hence*, *therefore*, *again*, *however*, *indeed*, and the like, are to be regarded as parenthetical introductions. They may be described as adverbial conjunctions, with no more right, usually, to be defended on either side by the humble comma, than *and*, *but*, and other conjunctions possess. Sometimes commas are wanted, however. The *Brighton Herald* cannot see why in the sentence "In quite a number of cases however the commas are better omitted" I leave "however" alone, while in the sentence, "Here, however, these is room for the practice" I put a comma on each side of the word. I had good reasons. In the first sentence the commas could be omitted: and whenever they can be they should be: nothing is more suggestive of inexperience in writing than failing to throw overboard every comma which can be spared. In the other case, putting in the commas threw the emphasis on "here," which was what I wanted.

There is a very just objection to the unnecessary or too frequent use of parentheses, but the feeling against them

is with many a mere prejudice. The proper rules for parentheses and the use of the dash, are, Use them when by so doing you diminish distraction, Avoid them when their use increases distraction. (I speak of diminishing and increasing distraction; for there is always some distractive effect in written matter.) I use parentheses freely, and some imagine that this results from over-quick writing, matters being thrown in between parentheses as a sentence runs on, which, had I written more slowly, would have come into a separate sentence. This is not the case. On the contrary, I am often at the pains to put within parentheses afterwards, matter which I had originally put by itself, judging (wrongly sometimes, mayhap, but still always after reflection) that the attention of the reader would be less distracted if a part of my reasoning came in as a passing thought, than if it were formulated separately after the break of a full stop. The passage between parentheses in the last sentence is a case in point: I wanted to show that I did not claim to be always right in opinions formed about parenthetical passages; but I did not deem it well to make such a remark separately after my sentence was finished, so I threw it in where it was wanted and where it would receive as much attention as it needed and no more.

With regard to colons and semicolons, I must say I differ from Sir Edmund Beckett. If there are any two "points" about whose use I never feel any doubt, the colon and the semicolon are the two. Apart from the work of the point-pepperer, who may have marred my intentions, I may confidently say that in all I have written since I first penned a line for publication—now just twenty years since—there is not a single colon which I would willingly see changed into a semicolon, or *vice versâ*. My own particular rule on that head is simply that a colon only should be used to separate complete sentences, which would be separated by a full stop were it not that you wish to indicate some connection between them,—as for instance that they both relate to the same subject, that subject not being the subject of the paragraph itself in which the colon-divided double sentence appears. (See the last sentence in the preceding paragraph, and also the last sentence in the next.)

The writer in the *Brighton Herald* objects to my theory that we should be economical of the comma; for he says it is wanted in long sentences though it may be spared in shorter ones. He has not quite apprehended my argument. It is precisely because the comma is so useful in long and involved sentences that we should economise it. In a short sentence we can throw in commas without fear of anything but distraction to the reader: in long sentences if we use the comma before it is wanted we are left without resource, save the too cumbrous semicolon, when the time of real need arrives.

I may in conclusion mention what I think some of my readers may be interested to learn. Twenty years ago, as I have said, I began to write. I was moved by a strong desire to give a clear and popular explanation of Doppler's Theory of the Colours of Double Stars, by which I had been much interested. I found myself so hard to satisfy, so far as forms of expression were concerned, that to write an article of nine pages I took about two months, writing sometimes only three or four lines a day. The article appeared in the *Cornhill Magazine* for December, 1863. Later (in 1864) when I was writing my book on Saturn, I still had so much difficulty in writing to my own satisfaction, that I would retain in my mind the reasoning of a whole chapter rather than begin the work of committing it to paper. I remember that when some delay occurred about the printing of the long and difficult chapter on "The Great Inequality," I imagined the printers must have lost the MS., and I wrote to tell them that I could replace the chapter, if they told me of the loss in time, knowing the whole of it by heart,—so laboured had been its production. It may be noticed by those who possess the first edition that there is but one passage, from beginning to end of the book, where any attempt is made at poetical description. That is in the concluding paragraph of Chapter III.; and though my mind was overflowing with thoughts of the beauties of the ringed planet, my pen refused to transcribe more than six lines. I went to school as a writer under a severe taskmaster—myself.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

IV.—THE DAISY.

Actinia bellis (Ellis and Solander.) *Actinia pedunculata* (Pennant.)

ACTINIA BELLIS in contour is very much like a daisy, but bears no resemblance to one in colouring. This anemone is highly valued by collectors, partly for its own sake and also because it is not easily obtained in good condition, on account of its habit of ensconcing itself in crevices and holes. When, therefore, the difficulty of capture has been overcome and a perfect specimen is secured, it is very much esteemed. In addition to which, when once settled in a tank or vase Daisy is almost invariably in full bloom, it is also very hardy and easily kept in health.

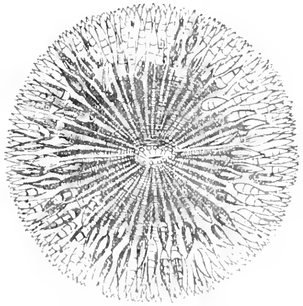


Fig 1. *The Bloom or Flower.*—The general surface of the disc is a horizontal plane, though in some instances it is slightly concave. The ordinary appearance of this anemone is fairly described as that of a saucer set upon a slender pedestal. The edge of the calyx is usually circular but sometimes it is frilled like a half-opened flower, and then has the appearance of being lobed.

The tentacles, arranged in about six rows, are inclined towards the centre or nearly erect in the inner row, and are much longer than those in the other rows. The total number of them in the six rows is estimated at about 500, arranged as follows, beginning with the innermost, $12+12+24+48+96+288=480$. The gonidal radii are frequently strongly marked, and in fine specimens this marking is extended by two tentacles, one on the side opposite to the other, which are larger by one third than any of the others, and not mottled like them, but of uniform colour, either cream-white or ochre. In some in-

dividuals there is only a single radius and one tentacle of this character, and in others there is no trace of either. The lips are rather thin and minutely furrowed.

There are two principal varieties of bellis, distinguished by the colour of its disk—one a dark chocolate brown, closely and evenly striped with bright scarlet, radiating from the centre to the edge. The lip in this variety is tinged with violet, and the tentacles are of a rich brown colour, relieved with blue-grey and opaque white.

The other variety is of a tamer brown, in several shades, relieved with grey and opaque white, and occasionally enlivened with light blue tints. There is a good coloured representation of this variety—disk, column, and button—in Gosse's "Rambles on the Devonshire Coast," p. 28, pl. 1.

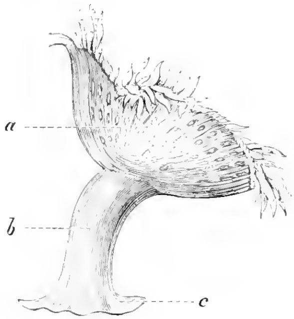


Fig. 2. *The calyx, &c.*—The calyx and the upper half of the pedunculus—*i.e.*, the stem—are studded with the whitish protuberances called warts, which are suckers. To these ordinarily, when the animal is first captured, sand-grains and fragments of shells are attached, and effectually conceal the parts so covered. When unobscured, the calyx is found to be grey, inclining to blue, which is toned down along the stem to whitish brown, and not unfrequently to a beautiful pink. The foot is invariably expanded, and very irregular in its outline.

The figure is extremely variable, and some curious examples of its variations are given in Dr. Johnston's "British Zoophytes," 2nd edition, p. 231. Within the space of a single hour Bellis will present a great variety of shapes. This Protean mutability of form is effected in two ways. First, by distension of the body with water until it nearly equals the disk in diameter; and, in the next place, by constricting itself in one part and constantly moving the position of this constriction.

When extended to the utmost limit the stem is slender and perfectly cylindrical.

Bellis is usually found in clusters of at least four or five individuals in each cluster, and crowded together in the same crevices or fissures, where their expanded disks press upon each other and form a continuous row of flower-like bodies.

Cornwall is called the metropolis of the English species. In Mount's Bay and along the Cornish coast daisy is the commonest of its genus. It is a littoral dwelling animal, and seldom met with except between tidal limits. Mr. Cocks (Johnston *ut supra*) points out that pretty Daisy will sometimes forsake those "wells of pure water"—the tidal pools—for what he describes as little better than a Stygian bog. "I found the beach," he writes, "composed of mud, sand, and decomposed algæ; many of the stones when lifted presented a face as black as the skin of an African, and sent forth a rich aroma of sulphuretted hydrogen. In turning the stones over, I was astonished to find in this Pandorian locality herds of the Actinia bellis in prime condition—jackets as red as a Kentish cherry—tubercles on external portion of the disk, light neutral tint, and strongly marked—so pugnacious that, when touched, water issued in full streams from nearly all the ducts or apertures. The ground is literally covered with them. The oral disk and the tentacula present a variety of tints—dark brown, light fawn, dark and light ochre, cream, &c.; all the tentacula (one excepted) are annulated. Each individual (I have fourteen in my bottles) has the ochre-coloured or white tentaculum—nearly one-third larger than any of the others—making one of the central row; and a white or buff mark, or line, extends from it to the angle of the mouth on each side."

Bellis is almost invariably stationary, rarely quitting its home or corner to which it has once become attached. Besides being able to produce the convolutions of calyx and peduncle, already described, it occasionally projects its disk and lips, which movement is called pouting, and it can retract completely both tentacles and disk when it appears in button form.

A curious habit, through not peculiar to Daisy, is thus described by Mr. E. W. H. Wordsworth:—"I have seen the elongation of one of the tentacles of the first row in Bellis. The ordinary shape and proportions were retained, but the arm was stretched to more than twice its natural length, yet without any appearance of unnatural tension or straining; it was constantly in motion, apparently feeling about for something, but assumed its usual size after a few hours."

Another observer noticed a tentacle on each extremity of the disk's diameter thrown out until the two together commanded an area of fully six inches in length by four in width. The space within this area was minutely examined by moving each tentacle in numerous circles and various elegant curves. The object of this singular movement was tested by placing a scrap of meat within reach of one of the elongated tentacles, when it was immediately seized and conveyed to the mouth.

(*To be continued.*)

JACK KETCH.

By Richard A. Proctor.

WHAT a pleasing effect the newspaper references to the "common hangman" are calculated to produce. Formerly, the subject was not considered very suitable for respectable papers. We could take up our *Times*, or *Daily News*, or *Standard*, with the assurance that, except in the accounts of executions, we should find no reference to the common hangman. Lately it has been different. One day we learned how the wretch who last held the office employed his leisure time; another day we were told how he had been allowed to visit the Houses of Parliament, and how among the 666 (or whatever the actual number) who represent the collective wisdom of our legislature, several showed marked attention to the degraded ruffian who had deliberately selected man-killing as part of the business of his life; next we hear of the details of his illness as if some great statesman or public benefactor were nearing his end; and now, with atrocious ill taste several of our daily papers (papers which may be laid each morning on the tables round which our wives and daughters sit) repeat the ghastly communications sent in by the murderous brutes who wish to be the next of our common hangmen! Truly those who provide matter for our journals are strangely

ill acquainted with the tastes of British readers; unless it is to be held that beneath a veneer of culture we have exceedingly coarse and savage tastes. Are we to suppose that in cock-fighting, bull-baiting, public prize fights, and other noble "sports" with which a "sentimental law-making" has interfered our innate savagery found a wholesome vent, and that now, wanting these, our people require to be supplied with "gallows news" to satisfy their hankering for what is savage and brutal? I fancy the leaders of public opinion (Heaven save the mark) might safely have credited us with better taste.

It may be urged that as we must have executioners so long as capital punishment is in vogue, the holder of the office ought not to be held in contempt, or regarded as necessarily a cruel and brutal wretch. There is, however, no *must* in the case. In America for the last half century there have been no "common hangmen" though capital punishment is still awarded and occasionally inflicted. On the Continent where there are executioners, their identity is concealed. No one in Great Britain was ever driven by want to take the office. The letters published so cheerfully in the public journals may at least serve a useful purpose in showing what manner of men hangmen are,—though this might have been guessed without so ghastly and degrading an exhibition.

As to the propriety of capital punishment, nothing need here be said. Taking the scientific view of the matter it may be noticed that Nature inflicts capital punishment relentlessly—if somewhat blindly—for less offences than those for which the law assigns the penalty of death. If there were no law for eliminating murderers from our midst they would be removed ere long without law; and systematic elimination is better than irregular removal. But in these days a more seemly system of capital punishment ought to be adopted.

Editorial Gossip.

A correspondent is exercised in his mind because at a recent meeting of the Astronomical Society certain doubts were raised respecting a point in the Lunar Theory. He tells me that a certain Mr. W. H. Phillips has devised "a new theory of a serpentine course of the moon" to which I ought, it seems, to have long since alluded. Mr. Phillips "says plainly," writes my correspondent, "that *your theory* and all astronomers *are wrong*, and that the Royal Astronomical Society had generously acknowledged his new discovery"—"so you see," he adds, referring to a former communication, "I am not mistaken in what he says about the Royal Astronomical Society owning to their being wrong in this matter of a Lunar Theory." This is not the first time that a discussion in the Astronomical Society about some matter far beyond the range of the general student, has been mistaken for an expression of doubt about an elementary matter. I remember that the late Mr. Reddie, paradoxist and founder of the Victoria Institute, was convinced that the Astronomical Society and the Astronomer Royal in particular, were coming round to his views, because Sir George Airy showed that the theory of the sun's proper motion in space was as yet by no means complete. Mr. Reddie had not the least idea what "the sun's proper motion in space" might mean; but he had ventilated some wild ideas about elementary astronomical matters and especially about the sun's fixity of position, so he immediately jumped at the conclusion that Sir George Airy had heard of these notions and was speaking of them. Now as a matter of fact Mr. Reddie's letters had long since found a place on the shelf which Sir George Airy had cruelly labelled,

"MY LUNATIC ASYLUM FOR LUNATICS."

It ought not to be necessary for me to explain that the doubts raised recently by Mr. Stone respecting the Lunar Acceleration have nothing whatever to do with the ordinary account given by astronomers respecting the moon's motion round the earth and (with her) round the sun. There never has been any doubt about this point since the Copernican theory was established,—and there never can be (that is, among astronomers). When astronomers speak of the Lunar Theory they do not refer to so elementary a matter as this; but to the mathematical analysis of those multitudinous perturbations which the moon's movements undergo, by which she is now swayed a little on this side now a little on that side, now a little above anon a little below, the course she would pursue if undisturbed in her combined elliptical paths around earth and sun. This course would differ little from an ellipse around the sun at one focus; for as Sir George Airy neatly put it (in a letter to Mr. Reddie) the moon may be regarded as a planet travelling around the sun but largely perturbed by the attractions of a neighbouring planet, the earth. The analysis of the other perturbations and of the constant fluctuations in the elements of the moon's apparent orbit round the earth, constitutes what is called the Lunar Theory, a subject which none but advanced mathematicians can hope thoroughly to grapple with, far less to deal with so as to advance our knowledge respecting it. The Differential and Integral Calculus is the A B C of the subject and of all kindred subjects. As we want to be a good deal beyond the A B C to read profitably, so must the mathematician be far beyond his first acquaintance with the "Dif-Cal" to follow the complex reasonings involved in the Lunar Theory.

Parts of the Lunar Theory remain still to be more fully explored than as yet they have been. Among these must be mentioned the Lunar Acceleration, that slight but measurable hastening of the moon in her course, by which she would not gain her whole apparent diameter in many centuries. It was supposed at the beginning of the present century that Laplace had explained this phenomenon fully, by his masterly analysis of the effect due to the gradual diminution in the eccentricity of the earth's orbit. But recently Professor Adams showed that when the analysis was carried somewhat farther half the acceleration remained still unaccounted for. After a long inquiry Adams' conclusions seemed established, and Delaunay suggested that the part of the acceleration unaccounted for might be apparent only, the real change being a constant but slow retardation of the earth's rotation; and he pointed to the tidal wave as capable of retarding the earth's rotation, though whether in sufficient degree to account for the estimated change, he could not say. And now further inquiry by Mr. Stone, Radcliffe Observer, indicates the probability that with further and deeper analysis the Lunar Theory may be able to account for the whole acceleration after all, without our having to assume any measurable retardation of the earth's rotation. Yet retardation of terrestrial rotation is doubtless taking place all the time.

The Delaunay mentioned in the preceding paragraph must not be confounded with the Delaunay who has ventilated absurd theories about the influence of the

planets in producing earthquakes. The latter, Captain Delaunay, made a happy hit in predicting a great terrestrial disturbance within two days of the time of the Javan earthquake. But a dozen such coincidences would not establish a theory so preposterous. As M. Faye said, commenting on Captain Delaunay's ideas, nothing is more certain in science than that the influence of the planets on terrestrial phenomena is *nil*.

Reviews.

OUR AMERICAN COUSINS.*

We have read many books about America, books meant to be brilliant, witty, humorous, profound, entertaining, and so forth; some meant to exhibit Americans as they are, others written to teach the Americans what they should be; books laudatory, and books scathing in denunciation. Here is a book which treats a subject one might suppose to be well worn, yet as full of freshness as though no one had ever yet written about America. There is no effort at effect, yet the account is thoroughly effective. We find here what a thoughtful Englishman, kindly but honest and just, has to say of that great nation which has grown on the other side of the Atlantic from European and chiefly from British blood. Mr. Adams has done thoroughly well what he sought to do, he has "presented a fair and accurate picture of so much of American life and American manners as came within his own observation." That there is much more of praise than of disapproval in this book proves the fairness of the writer; for no honest and intelligent Englishman can visit the United States without being impressed by the fact that in many most important matters, and especially in those which touch the dignity of manhood, the conditions there are more favourable than on this side of the Atlantic. But in his admiration for what is good Mr. Adams does not lose sight of less favourable conditions. He speaks plainly of what undoubtedly is the "rock ahead" for America, the readiness of Americans to suffer the control of affairs,—national government, state legislature, and civic administration, alike,—to be in the hands not of the best men, but of men who often are among the worst in the land. Because greedy and unprincipled men have grasped at power and wealth, the best men in America withdraw from politics, showing not true disinterestedness (though they *are* disinterested) but want of due interest in the welfare of city, State, and nation. Mr. Adams notes justly too one important cause of this—to wit, the unmeasured abuse poured by party papers in America (and what papers in America are not party papers?) on every candidate for office. With the certainty that however pure his motives, honest his zeal, and earnest his labours for his country's good, he will be abused by some if not most of the organs of public opinion as a scoundrel and a villain, the most patriotic American is apt to be deterred from the thought of giving his services to his country. The evil is deep-seated and affects the very life-blood of the nation.

We can say emphatically and truthfully of Mr. Adams's book that it is by far the best work of its kind we have yet seen. Reading it will correct many false impressions which Englishmen entertain respecting the great nation which their cousins have formed on the other side of the Atlantic. We do not agree with all that Mr. Adams says. (For instance, his love of freedom which we fully share, leads him to overlook, as it seems to us, the wrongdoings of those through whose action but against whose original intention, slavery was done away with.) But even his mistakes, or what appear to us as such, approve his fairness and justice. He presents throughout the facts as he sees them, and his insight is keen and true.

From this small and cheap work more may be learned about the real character of America and the Americans than from any book we have seen. We may add that the substance of Mr. Adams's book appeared originally in a series of articles contributed to that excellent weekly paper, the *Newcastle Weekly Chronicle*.

* "Our American Cousins": being Personal Impressions of the People and Institutions of the United States. By W. E. Adams. (Walter Scott: London).

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

VISUAL PHENOMENON; COLOURS OF FLOWERS; ERRATUM.

[934]—The phenomenon seen by Mr. Leonard Brown (letter 906) has been investigated by Mr. John Aitken, of Darroch, Falkirk. An account of his experiments will be found in the *Journal of Anatomy and Physiology*, for 1878 I believe; but as I have mislaid the author's copy which he kindly sent me, I am not sure as to date. No doubt, however, a letter on this subject sent by Mr. Brown to the above address would be courteously replied to.

For an experimental investigation of the colours of flowers, Mr. G. G. Hardingham may be referred to Dr. Sorby's paper on "Comparative Vegetable Chromatology" ("Proceedings of the Royal Society," No. 146, Vol. XXI., 1873). The paper is 41 pp. long, and cannot, therefore, be condensed into a paragraph. He confines his observations for the most part to colouring matters obtained from the leaves of the higher or the fronds of the lower classes of plants. I think, however, that Dr. Sorby would not undertake to say *how* colour is formed in flowers, inasmuch as he winds up his paper with this remark, "The storing up of the energy of the sun's rays in the various compounds formed by plants *is probably* so intimately connected with the optical and chemical properties of some of their coloured constituents, that the further extension of such inquiries as I have described may possibly assist in clearing up this very difficult and yet most important problem."

(On page 155, second column, line 5, for "ires" read "irises.")

William Ackroyd.

WART-CHARMING.

[935]—Apart from any superstitious credulity, I beg I may be allowed to entirely upset the "*simple explanation*" of "Mephisto" regarding Wart-Charming. An old gardener lived many years in our family. He was unlettered, but might be called "one of Nature's gentlemen." He was gifted with great imagination, and often, as children, we would listen with intense delight to him. He possessed the power of wart-charming. [Would one not rather say the power of impressing the minds of the warty ones?—R. P.] Brothers from school often applied to him for help in the cure of

these annoyances. I myself have shared in the effects of his mystic powers. The number of warts were given and faithfully counted by him in cutting notches on a stick. In strict secresy this stick was buried in the garden, [the gardener] uttering over it some charmed sentence, which no one was allowed to hear. The warts quickly vanished. A visitor in our family underwent the same treatment, with the same happy result. The warts were neither touched with saliva, or even looked at.

A Constant Reader of "Knowledge."

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[936]—As a subscriber to your excellent paper, Knowledge, I saw (in No. 81, for May 18, 1883, amongst "Letters to the Editor") a very interesting article under the heading of "Wart Charming." If you will kindly allow me, I will offer an experience of my own with regard to warts, which you are at liberty to insert in your paper if you think it of any interest.

When I was a boy of about fourteen years of age I happened to have upon the back of my right hand three to four warts. One day a friend, happening to notice them, said that he would soon drive them away, and there and then told me what to do. Said he, "Next time you see a female dog, put something sweet over the warts and make the dog lick them, as long as you can over five minutes. I laughed, as I had a suspicion that the gentleman was making fun of me.

However, I thought I would prove the gentleman's method any way. So for three days after was on the look-out, when at last I fell in with an old schoolmate who had a little bitch along with him. Immediately I made friends with her and patted the animal on the head kindly; then I placed a few crumbs of biscuit (I happened to be munching at the time) upon the warts, and offered them to the dog. She ate them up greedily and licked the place over and over again, when I would put more crumbs on the warts; this kept her licking long over five minutes. Then I went home soon after and forgot all about the occurrence, when, lo! a few days after I was suddenly amazed to find the warts gone, but the place where they had been was visible for a little time after and then disappeared also. I can answer for the truth of this, and, as far I am able to understand it, it is, as you say, in some way influenced by the mind over the body, the attention being called towards them.

Yokohama, July 12, 1883. Henry A. Vincent.

[The case illustrates "Mephisto's" theory, which no doubt has an element of truth in it, though the mind influence theory is not overthrown or even shaken by it.—R. P.]

DEAF CATS.

[937]—R. S. T. (850) writes of a family of deaf cats, whose deafness he attributes to in-and-in breeding. I, too, have some acquaintance with deaf cats. The first I met was given to me as a very small kitten, in Syria, by a gentleman who told me it would grow up deaf, adding as a fact in natural history, that all white cats with blue eyes are deaf. I took my kitten to Malta, when in due time he developed into a deaf cat. At Malta I lodged in a house where my landlady possessed a family of three white Persian cats, all of whom were deaf; of course, for anything I know to the contrary, in-and-in breeding may have been the cause in both cases, though certainly independently of each other, for my cat is not a Persian, and is like those belonging to my landlady only in colour. I may mention that my landlady is also acquainted with the quasi-physiological fact that white cats with blue eyes are invariably deaf.

I can answer for these animals not being deaf mutes, however. What a comfort it would be if this could be achieved by in-and-in breeding or any other means.

LETTERS RECEIVED, AND SHORT ANSWERS.

C. W. B. Yes; though your account is inexact, and your drawing, as you say, exaggerated. From the centre of whatever hemisphere of the earth is turned moonwards, a certain hemisphere of the moon is visible at any given moment; from points round the edge of that hemisphere of the earth, an observer can see a certain small distance beyond this hemisphere of the moon. The fringe of the moon's farther hemisphere thus brought into view, is about one degree of arc in breadth.—W. H. Bangall, B.A. The subject is excellent and Mr. Allen would treat it admirably; but so many subjects are excellent, and he is admirably treating subjects of his own choosing.—J. A. R. Of course the principle of such tricks is obvious; yet they interest many.—H. F. F. H. I do not know how rain-water may be kept sweet in a large wine cask.—James Burn. It is sad that none of the scientific contributors of the *Newcastle Weekly Chronicle* noticed your theory about the way in which the earth receives her heat. You have "formed the opinion that the rays of light when coming in contact with the atmosphere, after having passed through the frigid zone which encircles the globe either by an electrical or chemical action, lets loose the latent fire which the region of the air holds, as it were, in solution: by this means the earth will always have a sufficient supply of heat, and when it has done its duty it will again return to its aeral home." *I* have formed the opinion that I know no more than you do yourself what you mean. Try *this* theory:—The molecules of aqueous vapour supersaturated (as it were) with carbonic acid pass either by polar or magnetic action (so to speak) athwart the torrid zone which encircles the globe, and there bind the miasmatic emanations, which would otherwise pass away into the interplanetary æther; thus there is no waste, but (as one might say) a constant regeneration of (what may be called) the mundane heat fuel. "I trust I make myself understood."—H. Price. Whether, your eyesight being such as you describe it, at present, you will be able twenty years hence to see as well,—your age being now 30—I find myself unable to divine. I see as well now as I ever did in my life; but whether I shall be able to do so when I am fifty, I cannot say. How then can I tell you what your eyesight will be like a score of years hence.—Ed. Sheppard. You take three digits, selected by A, B, and C, multiply A's, by 20 and add twice B's, then multiply the sum by 30 and add 6 times C's; dividing the sum by 6 you have the three digits. Well this is not very surprising. Your process gives you,—1°, six times C's digit; 2°, twice B's multiplied by 30, or 60 times B's; and 3°, 20 times A's multiplied by 30, *i.e.*, 600 times A's: therefore naturally, dividing by six, you have C's digit, 10 times B's, and 100 times A's; *i.e.*, A's in the hundreds' place, B's in the tens' place; and A C's in the units' place.—Phonos. Know of no work that explains and teaches the thousand and one games that can be played with a pack of cards.

Erratum.—In the last line of Letter 926 (p. 173) 17·8″ E. of Greenwich should be 17·8 secs. (of time) E. of Greenwich.

Our Chess Column.

By Mephisto.

SOLUTION.

Problem No. 96, by J. Berger, p. 160.

1. Q to R5	1. K to Kt4
2. B to Kt6	2. K moves
3. Q mates accordingly	

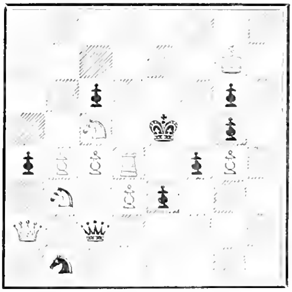
If 1. K to K6, 2. Q to K sq (ch), and 3. Q to Q2 mate; or if 1. P to K5, 2. Kt to Kt6 (ch), and 3. Q to K sq mate.

PROBLEM No. 99.

Fourth Prize Three-mover in the Nuremberg Problem Tournament.

By J. Berger, Graz.

Black.



White.

White to play and mate in three moves.

(We shall be pleased if our solvers will institute a comparison between this problem and the first-prize three-mover in Knowledge.

No. 89, p. 33. We think such a comparison will result favourably to the above composition).

GAME PLAYED ON THE 30TH OF JULY, 1883, IN THE NUREMBERG INTERNATIONAL CHESS TOURNAMENT.

SCOTCH GAMBIT.

White. Blackburne.	Black. Gunsberg.	White. Blackburne.	Black. Gunsberg.
1. P to K4	P to K4	14. QR to B sq	K to R sq (e)
2. Kt to KB3	Kt to QB3	15. Kt to B4	Q to R2
3. P to Q4	P takes P	16. P to QKt4	P to B4 (f)
4. Kt takes P	B to B4	17. P to K5 (g)	P to Kt4 (h)
5. B to K3	Q to B3	18. P takes P	P takes Kt
6. P to QB3	KKt to K2	19. B takes P	P takes P (i)
7. Q to Q2	Kt takes Kt (a)	20. B takes P	B to Q2 (j)
8. P takes Kt	B to Kt3	21. R to K7 (k)	Q to Kt3
9. Kt to B3	P to KR3 (b)	22. R takes B	KR to Q sq
10. B to B4	P to Q3	23. B to K5 (ch)	Kt takes B
11. Castles K R	Kt to B3 (c)	24. P takes Kt	R takes R
12. Kt to Q5	Q to Kt3	25. Q takes R, and White won.	
13. KR to K sq(d)	Castles		

NOTES.

(a) This is incorrect, for it not only gives White a good centre position, but also loses time, as the Black Bishop is forced to retire to Kt3. Stronger play than this is 7. B takes Kt. 8. P takes Kt (If 8. B takes Kt, Q to Kt3), P to Q4. 9. P to Q5, Q to Kt3, with an even game.

(b) Loss of time. 11. Q to Kt3 would have been better, as it would have somewhat retarded White's development and taken the Q out of reach of the White QKt.

(c) White's development is much superior to Black's. White threatened the dangerous move of P to B4, to be followed by P to K5, &c., when Black's game would soon become untenable. Kt to B3 obviously prevents P to B4 for the present.

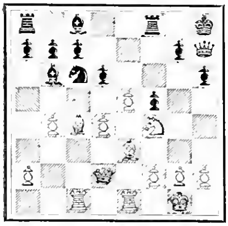
(d) Better than QR to K sq, for, as will be seen, the QR soon takes an active part in the game. P to B4 would not do, as Black could have replied with Q takes KP.

(e) B to Q2 instead would probably have been Black's safest course, as it would have enabled him to oppose the advance of White's centre by QR to K sq. It would have been bad to take the KP now, as White would obtain a winning attack, *i.e.*,

	14. Q takes KP
15. B takes P	15. Q takes QP
16. Q to Kt5 (threatening B takes KtP, &c.)	16. Q takes P (ch)
17. K to R sq	17. B to Q5
18. R to B sq	

and White should win by B takes P, following by Kt checking, &c.

(f) The move of B to Q2 would still have held good.



(g) A well-calculated move. By exchanging pieces Black could apparently win a P, but in reality he would lose, *i.e.*,

	P takes P
18. P takes P	Kt takes KP
19. B takes P	Kt takes B
20. R takes Kt	BP takes B
21. Q to Q6!	

and White should win.

(h) This is a very risky counter-attack, but Black had no satisfactory reply to the move of P to K5, the result of Black's prematurely playing P to B4, and delaying to develop his QB and QR.

(i) White has more than ample compensation for his piece in this interesting position. Black could not play B to Q2 on account of P to Kt5, which would win. The terrible check with the B on K5 wins the day for White, *i.e.*,

	19. B to Q2
20. P to Kt5	20. B to R4
21. Q to Kt2	21. B takes R
22. P takes Kt	22. Q to Kt3
23. P takes B	B to R4
24. P takes P, &c.	

(j) Black had to play all this under great pressure of time. R to Q sq seems stronger, but the nature of the position is such that White would have triumphed whatever Black played. White had three moves at his disposal in reply to R to Q sq, viz., (a) R to K7, or (b) P to Kt5, or B to B4, *i.e.*,

(a)	20. R to Q sq
21. R to K7	21. Q to Kt3
22. B to KB7	22. Q to Kt4

and we do not see any winning move for White; Black threatens both the R and the B. If White plays P to B4, Black could safely retire Q to Kt3. The best move for White in this position is probably 23. R takes Kt. Black obviously cannot take the Q, as White would mate in two moves by B checking and then B disc. ch. and mate, but Black would have a satisfactory reply in 23. P takes R. For if 24. B to K5 (ch), K to R2. 25. B to Kt6 (disc. ch.) (best), for 25. Q takes Q, P takes Q. 26. B to Q5 (ch), K to R3. 27. B takes P, B takes P. 28. B takes R, B takes B, and Black wins, as he threatens R to Q8). 25. K takes B (best). 26. R to Kt7 (ch), K to R4. 27. Q to K2 (ch), Q to Kt5. 28. R takes Q, P takes Q, and we do not see any immediate prospect of White winning (b).

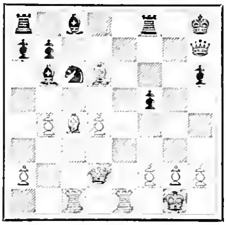
20. R to Qsq

21. P to Kt5

With this move we think that White can force the game whatever Black plays, *i.e.*,

21. Q to Kt3 (best). 22. B to B4, B to R4. (If Kt to R4, then 23. R to K7, Kt takes B. 24. R takes Kt, B to K3. 25. B to K5 (ch), K to Kt sq. 26. R to B3, &c.)

(Position after White's 20th move.)



23. Q to K3	B takes R
24. R takes B	B to Q2
(If Kt to R4, then 25. Q to K7 wins.)	
25. P takes Kt	B takes P
26. P to Q5	B to K sq
27. Q to Q4 (ch)	K to R2
28. R to K7 (ch)	B to B2
29. P to Q6	R to KB sq
30. P to Q7 (threatening B takes B, followed by P to Q8 (Q)	QR to Q sq
31. B to B7!	K to Kt sq
32. B takes B (ch)	R takes B
33. B takes R, and wins.	

If in the foregoing variation Black on his 22nd move plays Kt takes QP instead of B to R4, White would continue with 23. Q to Kt2; if then R to Q2. 24. R to B3, and White will soon obtain a winning advantage. Returning again to the position in the diagram, we find that, in reply to 21. P to Kt5, R takes B, can be played, but with similar unfavourable result, *i.e.*,

20.	R to Q sq
21. P to Kt5	R takes B
22. R to K8 (ch)	K to Kt2
23. P takes Kt, and White must win.	

(k) This move brings about a winning end game. P to Kt5 would also have won, but by a more complicated and difficult method.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. Furnival, G. W.—Problems received with thanks.

Correct solutions received:—Problem No. 96, G. W., W. Furnival. No. 97, W. Furnival, Schmucke, Warwick, John, W., G. W., Stettin. No. 98, Stettin, G. W., W., Warwick, Schmucke, W. Furnival, H. A. D.

H. A. D., in Prob. 97, if 1. B to B 8, P to B4, and there is no mate.

CONTENTS OF No. 98.

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AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPT. 28, 1883.

CONTENTS OF No. 100.

A NATURALIST'S YEAR.

By GRANT ALLEN.

BLACKBERRIES ARE RIPE.

IN all the hedgerows and on all the commons, now, the village children are eagerly filling crocks and baskets with the one great fruit of the year to them, poor little souls, the common wild blackberries. There is no bush more familiar in overgrown spots in England than the bramble, and yet there are few others the story of whose evolution is more interesting than that of this universally distributed British shrub. We can trace the entire history of the blackberry through its various gradations almost without transgressing beyond the limits of our own little native flora. The bramble kind are a special offshoot of the rose family, distinguished chiefly by their peculiar granulated berries, each of which consists of several tiny one-seeded, succulent fruitlets, united round the common receptacle into a single compound fruit. The origin of the race from the original central rosaceous stock, represented by the cinquefoil and other potentillas, is so clear and obvious that it well repays a few minutes' careful attention.

In their simplest existing forms, the rosaceous plants are low perennial herbs, with small yellow flowers, and tiny dry nut-like seeds, crowded together on a large flat or conical receptacle. This is the type familiar to all of us in the English cinquefoils, silverweeds, and tormentils; and from some such form, the whole of the widely varying rose family has slowly diverged in one direction or another. But it is not often that we can trace the steps of the divergence among surviving plants so clearly as in the case of the British blackberries. The lowest existing members of the blackberry genus are small creeping herbs, of simple habit, hardly differing at all from the potentillas except in the peculiar character of their granulated fruit. Of these very primitive kinds, the cloudberry of Northern Europe may be taken as an excellent example. It is a little unobtrusive plant, growing abundantly in the turfy bogs and tundras of Scandinavia, Russia, and Siberia, and still found in quantities in Scotland, though rare in Northern England and the Welsh hills. Like many other early forms, in fact, the cloudberry has now been stranded in Arctic or Alpine situations, while both it and its relatives have been driven entirely from more favoured southern climates by its own more advanced cousins, the raspberry, the blackberry, and the dewberry. The stem bears no prickles, and the leaves are simple and rounded in outline, or at most slightly lobed, instead of being deeply divided into separate leaflets, as in all the more advanced bramble types. Its flowers are large, as is often the case with Arctic blossoms, so as to attract the eyes of the rare northern butterflies or moths; and in this respect the cloudberry is just abreast of some higher potentillas, like the barren strawberry and the true strawberry, which have also progressed from yellow to white petals; while it is ahead of some other rather more developed members of its own genus, which, though in most respects superior to it, have not yet got beyond the primitive stage of yellow flowers. But it is the possession of the peculiar berry which at once marks off the cloudberry from the potentilla group, and points at its true place as an early embodiment of the blackberry type. This berry has been formed from the numerous hard dry carpels or nutlets of the potentillas through the selective agency of the northern birds, in whose scanty diet they form as important a part as they do in the usual stores of Arctic travellers. The outer coat of each little nut has grown soft and succulent, and has at the same time acquired a bright orange-red colour, to attract the attention of the friendly birds by whose aid its seeds are dispersed. The device is exactly analogous to that adopted unconsciously by the strawberry, only that in the strawberry it is the receptacle that becomes sweet and brightly-coloured, while the individual "seeds" or carpels (really small nuts) remain hard and unobtrusive: whereas in the cloudberry the receptacle is inconspicuous and dry, while the outer coat of the carpels has become succulent and ruddy. The mulberry (a tree belonging to a widely different family—that of the figs and nettles) has a granulated fruit even closer in some respects to that of the bramble: but each granule of the mulberry is produced from the carpels of a separate flower, while in the blackberry the whole set of carpels belong to a single blossom.

There are other little herbaceous bramble kinds besides the cloudberry, such as the pretty little *Rubus arcticus*, a very northern form, whose flowers have become pink, while its leaves are divided into three leaflets, like those of the strawberry; but these are of less importance in the genealogical order than our own British stone-bramble, a mountain plant of central and northern Europe, found pretty frequently in Scotland, in Yorkshire, and in the Welsh hills. In this ugly but interesting little plant, the buried rootstock sends up short greenish stems, very slightly armed with the first beginnings of prickles in the shape of small swollen and pointed projections. Sometimes, indeed, these rudimentary defences are altogether wanting; at other times they assume the form of fairly developed sharp spines. This is just what one would expect from the nature of the spots which the stone-bramble inhabits: a low, spreading herb, like the cloudberry, growing in broad northern bogs and tundras, has little need of protection against browsing herbivores; but comparatively tall and juicy stems, like those of the stone-brambles, growing in open woods or on broken mountain sides in the great backbone ridges of Europe and Asia, would soon get eaten down entirely by chamois, sheep, or other wild and domesticated ruminants, unless they were well protected by thorns or prickles from their herbivorous foes. How quickly the weeding action of the animals can produce the survival of protected specimens only is well seen on all the suburban

commons of Kent and Surrey, where the prickly variety of common rest-harrow alone can thrive; the more ordinary armed variety is all eaten down wherever it appears by the ubiquitous London donkey. The leaves of the stone-bramble are divided into three leaflets, after a fashion which runs more or less throughout the whole genus; and the flowers are in a sort of intermediate stage between dirty greenish-yellow and dingy yellowish-white. The red berries do not differ much, except in the fewness of the carpels, from those of the raspberry.

In the higher brambles—the raspberry, blackberry, and dewberry—we get the same type still further developed into a straggling woody bush. This growth in woodiness depends, of course, merely on the thickening and lengthening of certain cells and cell-walls in the stem, and it is everywhere readily produced by natural selection, wherever the circumstances are favourable to its evolution. Yet the difference between the stone bramble and the raspberry in this respect is far less than one might at first imagine; both have perennial creeping root-stocks as reserves of material; but that of the stone-bramble only sends up green annual shoots, herbaceous in character; while that of the raspberry sends up rather stouter and woodier biennial stems, which seldom outlive the second year. In the blackberry, they sometimes continue for three or four years together. Such gradual intermediate stages are almost universal in nature. At the same time that the higher brambles have acquired their woody and creeping habits, they have also acquired sharp prickles, rather weak in the raspberry, stout and usually hooked in the blackberry. These prickles not only serve to defend the plants against the cattle that browse (or the deer that once browsed) among the thickets where they love to grow, but also aid them in clambering over the bushes, hedges, or heaps of stones over whose top they usually straggle. The raspberry flowers are white; but the blackberry often shows a tinge of pink in its much larger petals which reminds us of such bigger and more developed rose-flowers as apple blossom, cherry blossom, and the true roses. Side by side with these changes, the leaves, now growing out into the open by the aid of the woody stems, can afford to expand more freely and widely; and so, instead of the simple lobed leaf of the cloudberry, or the trefoil leaf of the stone-bramble, these higher types have usually leaves of five leaflets, though the gradation from the three-leaved to the five-leaved form can almost always be observed upon the same plant. In the wild raspberry, as everybody knows, the fruit is still red, like that of most other brambles, but the blackberry seems to suit our native birds better, with its dark purplish-blue tinge, than any of these brilliant northern kinds. Indeed, it is noticeable that very dark-blue and black, which are extremely rare colours in flowers, are extremely common in wild fruits—for example in sloes, privet, whortleberries, wild madder, elderberries, dogwood, and wayfaring-trees. This seems to suggest a difference of taste in colour between birds and insects. The true blackberry has no bloom on the fruit, but in the variety known as the dewberry, and commonly accounted a species, the berry is covered with a delicate blue-black mealiness which makes it a very pretty object indeed. Blackberry brambles in fact, show an immense tendency towards variation—so much so, that while Mr. Bentham makes two British species, and Sir W. Hooker six, Professor Babington actually distinguishes as many as forty. As yet, however, it does not seem to me that any special selective action has been exerted upon these numerous varying forms, and, therefore, from the evolutionary point of view, they must be regarded as mere accidental sports, not as true botanical species.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XIX.

Referring to No. 17 of this series, August 1, a correspondent who has just returned from Norway, where he followed the route of my last trip there, reminds me of the marvellous congregation of sea-birds that assembles on some of the headlands of the Arctic Ocean, and suggests that egg-oil might be obtained in large quantities there. He quotes from the work of P. L. Simmonds on "Waste Products" the following:—"In the Exhibition of 1862 the Russian Commission showed egg-oil in large quantities and of various qualities, the best so fine as to far excel olive oil for cooking purposes;" but it was not sufficiently cheap for general use.

Among the places indicated by Mr. Grimwood Taylor, the most remarkable is Sverholt Klubben, a grand headland between the North Cape and Nord Kyn, rising precipitously from the sea to a height of above 1,000 feet. The face of the rock weathers perpendicularly, forming a number of ledges about two or three feet above each other, and extending laterally for more than a mile. On the two occasions when I passed it, the whole of this amphitheatre was occupied by a species of gull, the "kittiwake," perched on the ledges, their white breasts showing like the shirt-fronts of an audience of a million or two of male pigmies in evening dress. On blowing the steam-whistle, the rock appeared to advance, and presently the sky was darkened by a living cloud, and every other sound was extinguished by a roar of wings and the harsh wailing screams of a number of birds that I dare not estimate. The celebrated bird colony on the Bass Rock is but a covey compared with this.

The inhabitants of the little human settlement in the Bay of Sverholt derive much of their subsistence from the eggs of these birds; but whether they could gather a few millions for oil-making without repeating the story of the goose and the golden eggs, is questionable. The eider-ducks that inhabit some of the low mossy islands thereabouts, are guarded by strict legislative regulations during their incubation period, lest they should emigrate, and the down-harvest be sacrificed.

I now come to the subject of *stewing*, more especially the stewing of flesh food. Some of my readers may think that I ought to have treated this in connection with the boiling of meat, as boiling and stewing are commonly regarded as mere modifications of the same process. According to my mode of regarding the subject, *i.e.*, with reference to the object to be attained, these are opposite processes.

The object in the so-called "boiling" of, say, a leg of mutton is to raise the temperature of the meat throughout just up to the cooking temperature (see Nos. 3 and 4) in such a manner that it shall as nearly as possible retain all its juices; the hot water merely operating as a vehicle or medium for conveying the heat.

In stewing nearly all this is reversed. The juices are to be extracted more or less completely, and the water is required to act as a solvent as well as a heat-conveyor. Instead of the meat itself surrounding and enveloping the juices as it should when boiled, roasted, grilled, or fried, we demand in a stew that the juices shall surround or envelope the meat. In some cases the separation of the juices is the sole object, as in the preparation of certain soups and gravies, of which "beef-tea" may be taken as a typical example. *Extractum Carnis*, or "Liebig's

Extract of Meat" is beef-tea (or mutton-tea) concentrated by evaporation.

The juices of lean meat may be extracted very completely without cooking the meat at all, merely by mincing it and then placing it in cold water. *Maceration* is the proper name for this treatment. The philosophy of this is interesting, and so little understood in the kitchen that I must explain its rudiments.

If two liquids capable of mixing together, but of different densities, be placed in the same vessel, the denser at the bottom, they will mix together in defiance of gravitation, the heavy liquid rising and spreading itself throughout the lighter, and the lighter descending and diffusing itself through the heavier.

Thus, concentrated sulphuric acid (oil of vitriol) which has nearly double the density of water, may be placed under water by pouring water in a tall glass jar, and then carefully pouring the acid down a funnel with a long tube, the bottom end of which touches the bottom of the jar. At first the heavy liquid pushes up the lighter, and its upper surface may be distinctly seen with that of the lighter resting upon it. This is better shown if the water be coloured by a blue tincture of litmus, which is reddened by the acid. A red stratum indicates the boundaries of the two liquids. Gradually the reddening proceeds upwards and downwards, the whole of the water changes from blue to red, and the acid becomes tinged.

Graham worked for many years upon the determination of the laws of this diffusion and the rates at which different liquids diffused into each other. His method was to fill small jars of uniform size and shape (about 4 oz. capacity) with the saline or other dense solution, place upon the ground mouth of the jar a plate-glass cover, then immerse it, when filled, in a cylindrical glass vessel containing about 20 oz. of distilled water. The cover being very carefully removed, diffusion was allowed to proceed for a given time, and then by analysis the amount of transfer into the distilled water was determined.

I must resist the temptation to expound the very interesting results of these researches, merely stating that they prove this diffusion to be no mere accidental mixing, but an action that proceeds with a regularity reducible to simple mathematical laws. One curious fact I must mention—viz., that on comparing the solutions of a number of different salts, those which crystallise in the same forms have similar rates of diffusion. The law that bears the most directly upon cookery is that "the quantity of any substance diffused from a solution of uniform strength increases as the temperature rises." The application of this will be seen presently.

It may be supposed that if the jar used in Graham's diffusion experiments were tied over with a mechanically air-tight and water-tight membrane, that brine or other saline solution thus confined in the jar could not diffuse itself into the pure water above and around it; people who are satisfied with anything that "stands to reason" would be quite sure that a bladder which resists the passage of water even when the water is pressed up to the bursting-point, cannot be permeable to a most gentle and spontaneous flow of the same water. The true philosopher, however, never trusts to any reasoning, not even mathematical demonstration, until its conclusions are verified by observations and experiment. In this case all rational preconceptions or mathematical calculations based upon the amount of attractive force exerted between the particles of the different liquids are outraged by the facts.

If a stout, well-tied bladder that would burst rather than allow a drop of water to be squeezed mechanically through it be partially filled with a solution of common washing soda, and then immersed in distilled water, the soda will make its way out of the bladder by passing through its walls, and the pure water will go in at the same time; for if, after some time is allowed, the outer water be tested by dipping into it a strip of red litmus paper, it will be turned blue, showing the presence of the alkali therein, and if the contents of the bladder be weighed or measured, they will be found to have increased by the inflow of fresh water. This inflow is called *endosmosis*, and the outflow of the solution is called *exosmosis*. If an india-rubber bottle be filled with water and immersed in alcohol or ether, the endosmosis of the spirit will be so powerfully exerted as to distend the bottle considerably. If the bottle be filled with alcohol or ether and surrounded by water it will nearly empty itself.

The force exerted by this action is displayed by the rising of the sap from the rootlets of a forest giant to the cells of its topmost leaves. Not only plants, but animals also, are complex osmotic machines. There is scarcely any vital function—if any at all—in which this osmosis does not play an important part. I have no doubt that the mental effort I am at this moment exerting is largely dependent upon the endosmosis and exosmosis that is proceeding through the delicate membranes of some of the many miles of blood-vessels that ramify throughout the grey matter of my brain. But I must wander no further beyond the kitchen, having already said enough to indicate that exosmosis is fundamental to the philosophy of beef-tea extraction, and reserve further particulars for my next paper.

Postscript.—I feel bound to step aside from the proper subject of these papers to make public acknowledgment of an act of honourable generosity, especially as many hard things have been said concerning American plagiarism of the work of British authors. As everybody knows, we have no legal rights in America, and any publisher there may appropriate as much of our work as he chooses. American *legislators* are responsible for this. Nevertheless, I received, a short time since, a letter from Mr. E. L. Youmans, of New York, enclosing a cheque for £20, as an honorarium in consideration of the fact that these papers are being reprinted in the *Popular Science Magazine.* Shortly before this, a similar remittance was sent from another publisher (Messrs. Funk & Wagnalls), who have reprinted "Science in Short Chapters." These facts indicate that some American publishers have larger organs of conscientiousness than the present majority of American legislators.

I am told that another American publisher has issued another reprint of "Chemistry of Cookery" without making any remittance; but, as Mr. Proctor would say, "this is a detail."

THE ANTIQUITY OF MAN.*

By W. Pengelly.

PREVIOUS to 1858 all geological evidence respecting the antiquity of man was received with apathy and indifference. Early in the present century the Rev. J. M'Enery discovered flint implements beneath a thick continuous sheet of stalagmite in Kent's Cavern, Torquay, but when he submitted these specimens to Dr. Buckland, then the leading geologist of the day, the latter refused to regard them as evidences of the antiquity of man, but was of opinion they belonged to the ancient Britons, who "had scooped out ovens in the stalagmite," thus

* Abstract of an address delivered at the British Association.

accounting for their presence in the diluvium. This opinion Dr. Buckland held notwithstanding Mr. M'Enery's statement that in no instance had he discovered evidence of breaches or ovens in the floor, but one continuous plate of stalagmite diffused uniformly over the loam. In justification of Dr. Buckland's conduct, it should be mentioned that he himself had explored Kent's Cavern previously to Mr. M'Enery's researches therein, and, while doing so, had discovered a flint implement. This, however, he found under such circumstances as did not conflict with his published opinion on the low antiquity of man.

But it is doubtful whether even Dr. Buckland's faith in his early convictions remained unshaken to the end, for when pressed by an intimate friend, a Professor at Oxford, to prepare a new edition of his "Reliquæ Diluvianæ" and his "Bridgewater Treatise," he excused himself on the ground that the work would not be editing "but rewriting."

In 1840 Mr. Godwin Austen, F.G.S., read a paper before the Geological Society of London on the Bone Caves of Devonshire. Speaking of Kent's Cavern, Mr. Austin said that human remains and works of art, such as arrow-heads and knives of flint, occurred in all parts of the cave, and throughout the entire thickness of the clay, and no distinction founded on condition, distribution, or relative position, could be observed, whereby the human could be separated from the other *reliquæ*. He also expressed the opinion that the bones and works of art must have been introduced into the cave before the flooring of stalagmite had been formed. These statements, however, attracted little or no attention at the time.

In 1846 the Torquay Natural History Society appointed a committee, consisting of Dr. Battersby, Mr. Vivian, and Mr. Pengelly, to make a few diggings in Kent's Cavern for the purpose of obtaining specimens for their museum. In the report of their investigations this committee stated that they had established the important point that relics of human art were found beneath the unbroken floor of stalagmite. After taking every precaution by sweeping the surface and examining most minutely whether there were any traces of the floor having been previously disturbed, they broke through the solid stalagmite in three different parts of the cavern, and in each instance found flint knives. In the spot where the most highly finished specimen was found, the passage was so low that it was extremely difficult with quarrymen's tools and good workmen to break through the crust, so that the supposition that it had been previously disturbed was impossible. But such was the incredulity with which the inferences deducible from these facts were received that when the report was printed in the "Quarterly Journal" of the Geological Society, it was formally announced that the authors alone were responsible for the facts and opinions contained in their respective papers.

This state of incredulity and apathy lasted until 1858, when some workmen engaged in a limestone quarry on Windmill-hill, near the fishing town of Brixham, in South Devon, unexpectedly broke a hole through what proved to be the roof of an unknown and unsuspected cavern. A committee of exploration was immediately appointed and placed under the superintendence of Professor Prestwich and Mr. Pengelly. The facts which mainly contributed to the decision to have this cave systematically explored were that it was a virgin cave which had been hermetically sealed during an incalculably long period, the last previous event in its history being the introduction of a reindeer antler found attached to the upper surface of the stalagmite floor, and therefore it was free from the objection sometimes urged against Kent's Cavern—namely, that, having been known from time immemorial, and up to 1825 always open to all comers, it had perhaps been ransacked again and again: secondly, it was believed and proved to be a comparatively small cavern, so that its complete exploration was not likely to require a large expenditure of time or money.

At the end of a period of twelve months, during which time the cave had been subjected to a thorough and searching investigation, the committee were able to report that eight flint tools had been found in various parts of the cavern, all of them inosculating with bones of mammalia, at depths varying from nine to forty-two inches in the cave earth, on which lay a sheet of stalagmite from three to eight inches thick, and having within it and on it, relics of lion, hyæna, bear, mammoth, rhinoceros, and reindeer.

The results of these explorations at Brixham had an enormous influence in impressing the scientific world generally with the value and importance of the geological evidence of man's antiquity.

Among the first fruits of the awakening was a paper by Professor Prestwich, read to the Royal Society, May 26, 1859, on the occurrence of flint implements associated with the remains of animal of extinct species in beds of a late geological period in France at Ameins and Abbéville, and in England at Hoxne. In this paper Professor Prestwich distinctly stated that it was the discoveries which he had witnessed at Brixham which first fully impressed him with the validity of the doubts thrown upon the previously prevailing opinions with respect to such remains in caves. Sir Charles Lyell, too, in his address to the Geological Section of the British Association at Aberdeen, September, 1859, stated that the facts brought to light in connection with the explorations in the Brixham Cave had prepared geologists to admit that scepticism in regard to the cave evidence in favour of the antiquity of man had been pushed to an extreme.

But probably the greatest proof of the change of opinion which began to take place in the scientific world in regard to this subject was that no less than three editions of Sir Charles Lyell's bulky work on the "Antiquity of Man," which first appeared in February, 1863, were published in the course of ten months.

The result of the researches at Brixham quickened a desire to re-examine the Kent's Cavern evidence, and, accordingly, in 1864, a committee was formed, and received a grant of money from the British Association for that purpose. The investigation was begun on March 28, 1865. The committee was annually reappointed, and the work continued without intermission to June 19, 1880. The total money grants amounted to £1,900, together with £63 received from various private sources.

In M'Enery's work was a diagram of three remarkable canine teeth, belonging to a group of carnivoræ to which in 1846 Professor Owen gave the name of *Machairodus latidens*. A considerable amount of scepticism existed for many years as to whether these specimens were really found in Kent's Cavern, it being contended that, from its zoological affinities, *Machairodus latidens* must have belonged to an earlier fauna than that represented by the ordinary cave mammals. It was therefore naturally hoped that the re-exploration of the cavern would set this question at rest.

However, it was not until after the lapse of seven years and four months that the President, while engaged in washing a "find," discovered a well-marked incisor of *Machairodus latidens* with a left ramus of lower jaw of

bear, in which was one molar tooth. This at once established M'Enery's accuracy, left no doubt that *Machairodus latidens* was a member of the cave earth fauna—whatever the zoological affinities might say to the contrary—and proved that man and *Machairodus* were contemporaries in Devonshire.

When their exploration began, and for some time afterwards, the committee had no reason to suspect that the cavern contained anything older than cave earth. At the end of the first five months, however, facts pointing apparently to earlier deposits began to present themselves, and when, after the expiration of three years, a vertical section was cut, there was shown in clear, undisturbed succession, not only the cave earth with the granular stalagmite lying on it, but under, and apparently supporting the cave earth, another thicker and continuous sheet of stalagmite called crystalline, and below this, again, an older detrital accumulation known as the Breccia, made up of materials utterly unlike those of cave earth. The Breccia was just as rich as the cave earth in osseous remains, but the lists of species represented by the two deposits were very different. The remains of the hyæna prevailed numerically very far above those of any other mammal in the cave earth, his presence being attested by his teeth-marks on a vast number of bones, by lower jaws—including those of his own kith and kin—of which he had eaten off the lower borders as well as the condyles, by long bones broken obliquely just as hyænas of the present day break them, and by surprising quantities of his coprolites. In the Breccia, however, there was not a single indication of his presence, the crowd of bones and teeth belonging almost entirely to bears. No trace of man was found in the Breccia until March, 1870, when a flint flake was met with in the third-foot level, which was believed to be not only a tool, but to bear evidence of having been used as such. Two massive flint implements were discovered in the same deposit in May, 1872.

At various times other tools were found, until at the close of the exploration the Breccia had yielded upwards seventy implements of flint and chert. All the stone tools, both of cave earth and Breccia, were Palæolithic, and were found inosculating with the remains of extinct mammals, but a cursory inspection showed them to belong to two distinct categories. Those found in the Breccia, the more ancient series, were formed by chipping a flint nodule or pebble into a tool, while those from the cave earth were formed by first detaching a suitable flake from the nodule, or pebble, and then trimming the flake—not the nodule—into a tool.

The fact, however, most significant of time and physical change was the presence of the hyæna in the cave earth or less ancient, but not in the Breccia or more ancient of the two deposits. This fact rendered it almost impossible to avoid the conclusion that the hyæna was not an occupant of Britain during the earlier period. The acceptance of such a belief, however, would necessitate the adoption of the view that man was resident in Britain long before the hyæna, and also that it was possible for the hyæna to reach Britain some time between the deposition of the Breccia and the deposition of the cave earth. In other words, that Britain was part of the continent during this interval.

In support of this argument, it is to be remembered that Sir Charles Lyell recognised the following geographical changes within the British area between the newer pliocene and historical times—firstly, a pre-glacial continental period, towards the close of which the Forest of Cromer flourished and the climate was somewhat milder than at present; secondly, a period of submergence, when the land north of the Thames and Bristol Channel and that of Ireland was reduced to an archipelago. This was part of the glacial age, when icebergs floated in our waters. Thirdly, a second continental period, when there were glaciers in the higher mountains of Scotland and Wales. Fourthly, the breaking up of the land through submergence and a gradual change of temperature, resulting in the present geographical and climatal conditions.

The fact that neither in the Kent's Cavern Breccia, nor in the Forest of Cromer were any remains of hyæna found, and that the list of mammalian remains found in the one does not clash with those found in the other, renders legitimate the inferences that the hyæna did not reach Britain until its last continental period, and that the men who made the Palæolithic nodule tools found in the oldest-known deposit in Kent's Cavern arrived either during the previous great submergence, or, what is more probable, unless they were navigators, during the first continental period. There was little doubt, therefore, but that the earliest Devonians were either of glacial or pre-glacial age. Of course, the discovery of remains of hyæna in the forest bed of Cromer, or any other contemporary deposit, would be fatal to the argument, but it would leave intact all other evidence in support of the doctrine of British glacial or pre-glacial man.

THE SUN'S DISTANCE.*

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

The problem which is to engage our attention has been justly regarded as one of exceptional interest and importance. It seems not unlikely that in early ages the distance of the sun was one of the very first astronomical problems which ever attracted speculation. In modern times, as the problem has gradually approached solution, the interest attached to it has gradually increased until it has culminated in the last few months by the occurrence of the transit of Venus.

The importance of this problem arises from the fact that the distance of the sun is the base line in terms of which almost every other linear magnitude in astronomy is to be expressed. An accurate measurement of this base will infuse accuracy into all the other astronomical quantities which spring from it. When we have learnt the distance of the sun we can measure the bulk of the sun and his diameter, we can measure the great planet Jupiter or the rings of Saturn, and the scale of the whole solar system becomes known to us. Again, when we attack the loftiest problem in practical astronomy, and seek to stretch a sounding line over the vast abyss which divides our system from the stars, it is the distance of the sun which we must use as our measuring rod. No pains should be spared to give to so fundamental a unit all the precision of which it is capable.

Let us define accurately the magnitude to be measured. The actual distance from the earth to the sun is not constant. In these autumnal months the distance is rapidly decreasing. We are at this moment drawing nearer and nearer to the sun at the rate of a thousand miles an hour. Next Christmas we shall be about a million-and-a half miles closer to the sun than we are to-night. At the commencement of the new year we shall begin to recede. Next midsummer will find us as far from the sun as possible; then we shall draw in again, arrive next autumn

* A discourse delivered at the second general meeting of the British Association at Southport.

where we are this autumn, and commence anew the cycle of changes I have indicated. Though these changes amount to millions of miles, yet they are at the utmost only a small fraction of the sun's distance. To superficial observation the sun always seems the same size, and hence there can be no great relative changes in its distance.

There is no difficulty is understanding what is meant by the average distance of the sun. To express the idea with precision we may borrow the language of mathematics, and say that the distance from the earth to the sun consists of two parts—a large constant part and a small periodical part. The important problem, and the difficult problem, is the measurement of the large constant part.

The early history of the subject is as easy to sketch as the latter part is difficult. For fourteen centuries the doctrines of Ptolemy were adopted on the distance of the sun as on all other astronomical problems. The method of Ptolemy might have succeeded if the sun's distance could have been measured by thousands of miles instead of by tens of millions. As matters stands, Ptolemy's method was utterly inadequate to cope with the real difficulties of the question. It led him to a conclusion which we now know to have fallen far short of the truth. The real distance of the sun is twenty times as great as that which Ptolemy deduced from his observations. But Ptolemy's result was a great step in advance, notwithstanding the tremendous error by which it was vitiated. It was, at all events, an honest attempt to solve the problem by a direct appeal to nature, and he succeeded so far as to demonstrate the great truth that the sun is larger than the earth.

It is somewhat remarkable that the first reasonable approximation to the sun's distance was obtained by what can only be described as a well-considered guess. The illustrious Huyghens, in the seventeenth century, hazarded a speculation, which seemed plausible at the time, and which we now know to have been reasonably correct. Huyghens compared the diameter of the planet Mars with the sun. He compared the diameter of Venus with the sun. The primitive instruments used were capable of making these measures with some accuracy. Huyghens knew that the earth was also a planet revolving outside the path of Venus and inside that of Mars. Was it not reasonable to assume that the bulk of the earth might be comparable with that of its fellow planets, and intermediate between the bulk of Venus and that of Mars? This assumption—and, of course, it was no more than an assumption—gave the means of guessing the distance of the sun, which was concluded to be about 100 million miles.

When guesswork came to be replaced by measurement, this estimate of the sun's distance was corrected. It was found to be too large. It was amended first to 95,000,000 miles, then to 91,000,000 miles. This was subsequently found rather too small, and it is now generally thought that the sun's distance must be more than 92,000,000 miles but hardly so much as 93,000,000 miles. We have here a range of one million miles.

The problem in its present condition can now be distinctly stated. We require to determine the sun's distance accurately to within 100,000 miles, or, to speak in round numbers, we desire to determine the distance of the sun accurately to one-thousandth part of its total amount. Is such a degree of accuracy obtainable? I believe that it is. I do not say that the problem has already been solved with this precision, but an approach has been made, and enough has been done to show that the accuracy I have indicated may be attained. But this margin is not really large when we reflect on the stupendous magnitude of the sun's distance.

A favourite illustration in books of astronomy states that a journey to the sun in an express train running night and day without stopping would consume about 300 years. Before entering on such a journey it would, however, be well to recall to mind a very interesting lecture on railway accidents delivered by Sir F. Bramwell to this association a few years ago. From the figures available he showed that supposing a man made up his mind to be killed by a railway accident it would usually be necessary for him to travel day and night by express trains for 900 years before he could be quite certain of achieving his purpose. One or two return trips to the sun would no doubt suffice.

There are certain conditions which any method of measuring the sun's distance must fulfil. In the first place, it is obvious that we cannot measure the distance directly. We cannot take a tape and measure it as we would the length of a field. We are compelled to resort to indirect methods. In other words, instead of measuring the sun's distance directly, we measure something else, from which we derive the sun's distance by calculation. Whatever that something else may be, there is one obvious condition which must be fulfilled. The method by which the calculation is to be made must be absolutely unimpeachable. The measurable quantity and the sun's distance must be connected together by inexorable logic. The theory may be difficult, but it must contain no trace of ambiguity or of indefiniteness. No question of mere judgment or of estimation should be admissible. The connection between the two results must be as tight as a demonstration in geometry.

Another condition, alike obvious and important, must be specified. Whatever be the measurable quantity, be it the displacement of a planet, a lunar inequality, or the co-efficient of aberration, our measurements are subject to error. Sometimes the measured quantity will be too large, sometimes it will be too small. It is necessary to have an organised plan of symmetrical measurement, so that the number of measurements which are too great shall be as nearly as possible equal to the number of measurements which are too small. This condition is secured by forethought in arranging the details, and by vigilant suspicion of error from every conceivable source. The observations or measurements can then be purged from error by the well-known method of taking the mean. The success of this operation depends upon the number of observations that have been accumulated. It is, therefore, desirable that any proposed method of finding the sun's distance should admit of repeated application. Once we are assured that the observations contain no predisposition to be all too large or all too small, the mean will afford a result vastly more accurate than the original observations. It will do more than this—it will tell us not only what the result is, but how far that result is entitled to our confidence.

Let me venture on an illustration to show how accuracy may be obtained from the mean of inaccurate results. Suppose the question were to be asked this evening—What o'clock is it? and suppose that every lady and gentleman were at the same moment to look at their watches, we should have, I suppose, a thousand watches or so brought to bear on the question. Perhaps I am not wrong in supposing that, if the trial were made, the thousand watches would exhibit some degree of variety. Some, no doubt, would be right, some would be a minute or two wrong, some, perhaps, would be five minutes wrong, or even more. But though there may be a general tendency in watches to be wrong, I believe no one can assert that as a whole they exhibit any particular preference to being fast rather than slow. There are, perhaps, some hundreds of watches in the

room more or less fast, and there are probably an equal number of hundreds more or less slow. This is precisely the state of affairs that every astronomer likes. He would, under such circumstances, tolerate even watches that were very far wrong. It is quite possible that one or two of the watches present may have stopped altogether; they were not wound last night, or the spring is broken. Shall we then exclude such watches when we proceed to take the mean? It is unnecessary to do so. Even if a watch were five or six hours behind time it would only make the mean slow by about one-third of a minute, and in all probability this would be compensated by some other watch several hours too fast. The principle is sufficiently obvious. Each watch represents a more or less accurate attempt to tell the time. There is no particular bias for the watches to be fast rather than to be slow, and the greater the number the more accurate will the mean be.

The moral is obvious. If we wish to determine the sun's distance the method employed must admit of a very large number of measures being made. [About] half will be too large, [about] half will be too small, and the mean of all will afford a result which may be relied on. The various considerations I have brought forward may be considered to merge in the general condition that any proposed method must admit of the determination being made to within a thousandth part of its total amount. With this canon of criticism I shall briefly review the various methods in use, and in doing so I am glad to acknowledge how much I have profited by the labours of Mr. Gill, her Majesty's Astronomer at the Cape of Good Hope, who has, with characteristic energy, devoted himself to the discussion of this problem.

(*To be continued.*)

THE MORALITY OF HAPPINESS.

By Thomas Foster.

CHAPTER IV.—RIGHT AND WRONG.

(*Continued from page 167.*)

In its scientific aspect, then, as indicated by processes of evolution, conduct is good in proportion as it tends to increase the quantity and the fulness of life, bad in proportion as it exerts a contrary influence. Conduct may tend to increase life in its fulness directly or indirectly, proximately or remotely; and again conduct may in one aspect increase while in another aspect it may diminish the fulness and quantity of life: but our definition of good and bad conduct is not affected by such considerations. Just as a knife may be a good knife for cutting bread and a bad knife for cutting wood, just as a business transaction may be good in relation to some immediate purpose yet bad when remoter effects are considered, so can we truly apply to conduct the terms *good* and *bad* in reference to one set of considerations even though we may have to invert the terms when conduct is considered in reference to another set of considerations. But always, in its scientific aspect, conduct is to be regarded as good where it increases life or the fulness of life, and bad where it tends the contrary way.

When we separate conduct ethically indifferent from conduct in its strict ethical aspect, it is convenient to substitute for the words *good* and *bad* the words *right* and *wrong*. But the change is slighter than at first sight it appears. Indeed the more carefully the question of rightness or wrongness,—the question of *duty*,—is considered, the more thoroughly does the kind of conduct judged to be morally indifferent merge into that which we regard as praiseworthy or censurable.

Taking first those parts of conduct which relate directly to the quantity or to the fulness of individual life, we find that while the terms good and bad are freely applied to them, and even the terms right and wrong, they are for the most part regarded as morally indifferent. When we say you *ought* to do this or to refrain from that, the idea of duty is often not really present, so long as the act in question relates to a man's own life or its fulness. Even when we use words of praise or censure in relation to such acts, they do not imply that a moral obligation has been discharged or neglected. The reason doubtless is that, as a rule, men need little encouragement to look after those parts of their conduct which affect themselves and their own interests. For it may be observed that where it is likely there may be want of due care or wisdom in such matters, there we find distinct exceptions to the general rule just indicated. So far as quantity and fulness of life are concerned, the man who crosses a crowded thoroughfare carelessly, he who neglects his business, and he who wears insufficient or unsuitable clothes in cold and wet weather, act with as little propriety in their adjustments, as is shown by the man who steadily drinks intoxicating liquors. But while none preach such duties as caution in street crossing, prudence and energy in business, and care about clothing, at least as duties morally obligatory, quite a number of persons preach against steady and heavy drinking as against a moral offence. The Bible indeed does not, though it has many a word of advice against wine-bibbing; yet even in the Bible we find evidence of the early existence of total abstainers, and it is altogether unlikely that those ancient Blue-Ribbonists omitted to recognise sinfulness in all who did not share their views and follow their practices. Here we find evidence of the law of moral philosophy that a system of ethics, with recognition of moral rightness and wrongness, only begins to be formed where the best conduct (so far as fulness of life is concerned) runs the chance, for whatever reason, of being neglected, and inferior conduct followed. In this case, the best conduct is apt to be neglected because the increased fulness of life to which it conduces is more remote than the temporary increase of life fulness to which inferior conduct tends.

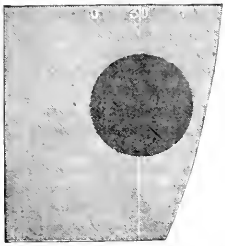
Yet speaking generally it may be said that as Mr. Herbert Spencer puts it,—"The ethical judgments we pass on self-regarding acts are ordinarily little emphasised; partly because the promptings of the self-regarding desires, generally strong enough, do not need moral enforcement, and partly because the promptings of the other self-regarding desires, less strong, and often over-ridden, do need moral enforcement."

When we turn to the life-regarding actions of the second class, those which relate to the rearing of offspring, we no longer find the words good and bad, right and wrong, used with doubtful meaning. Here the question of duty is clearly recognised. The conduct of parents who by neglecting to provide for their children's wants in infancy, diminish their chances of full and active life, or of life itself, is called bad and wrong not solely or chiefly because it is not favourable to the increase of life, but as open to moral censure. In like manner, men blame as really wrong, not merely unwise or ill-adjusted, such conduct as tends to make the physical and mental training of children imperfect or inadequate.

Still clearer, however, is the use of the words right and wrong as applied to conduct by which men influence in various ways the lives of their fellows. Here the adjustments suitable for increasing the fulness of individual life

VAST SUN-SPOTS, &c. (*See opposite page.*)

DEC. 6, 1882, 2.25 P.M.



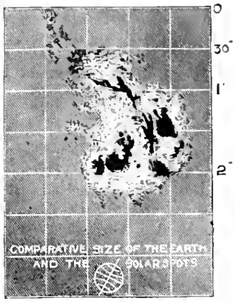
TRANSIT OF VENUS, 1882.

Apparent Size and General Appearance of Venus, as seen projected on a Screen.

Aperture, 3 inches. Focal length, 45 inches. Power 80.

(The "Ligament" was glimpsed as a dusky band. Did not observe any central bright spot.)

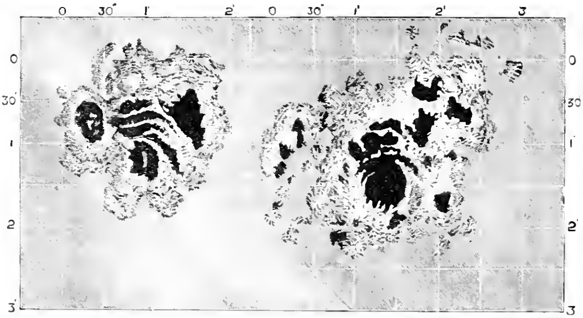
APRIL 19, 1882, 3.30 P.M.



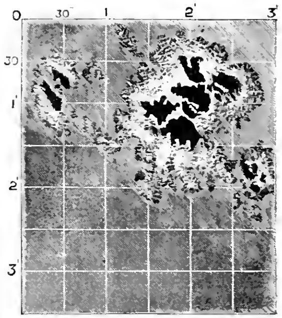
VAST SOLAR SPOT OF APRIL, 1882 (accompanied with an intense Magnetic Storm).

Extreme length, 2′ 0″. Mean breadth, 0′ 45″.
∴ Area = ± 1,093,500,000 square miles.

Nov. 15, 1882, 10.47 A.M. Nov. 19, 1882, 10.20 A.M.



Nov. 21, 1882, 10·50 A.M.



HUGE SOLAR SPOT OF NOVEMBER, 1882 (accompanied with an intense Magnetic Storm).

Extreme length, 2′ 12″
Mean breadth, 1′ 30″
∴ Area = ± 2,405,700,000 square miles.

Extreme length, 3′ 10″
Mean breadth, 1′ 30″
Area ± 3,462,750,000 square miles!

Extreme length, 2′ 0″
Mean breadth, 1′ 30″
∴ Area ± 2,187,000,000 square miles.

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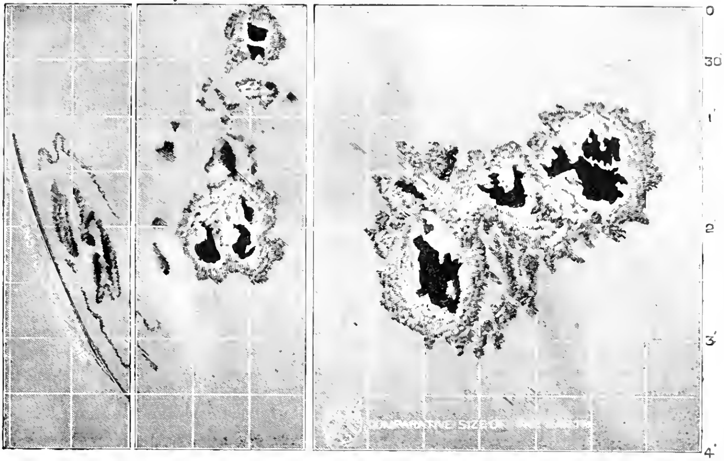
or for fostering the lives of offspring (alike in quantity and fulness), are often inconsistent with the corresponding adjustments of others. The development by evolution of conduct tending to the advancement of individual lives or lives of offspring would of itself tend constantly to acts inconsistent with the wellbeing or even with the existence of others, were it not for the development (also brought about, as we have seen, by processes of evolution) of conduct tending to the increase of the quantity and fulness of life in the community. But there arises a constant conflict between tendencies to opposite lines of conduct. It is so essential for the welfare of the community that tendencies to advance the life interests of self and children should be in due subordination (which is not the same thing be it noticed, as complete subordination) to tendencies leading to the furtherance of the fulness of life in others, that rules of conduct towards others than self or children have to be emphatic and peremptory in tone. Hence it is, as Mr. Spencer justly remarks, that the words good and bad have come to be specially associated with acts which [respectively] *further* the complete living of others and acts which *obstruct* their complete living.

(*To be continued.*)

DURING fourteen days, recently, five accidents with hydraulic lifts occurred in the City, by which four persons lost their lives.

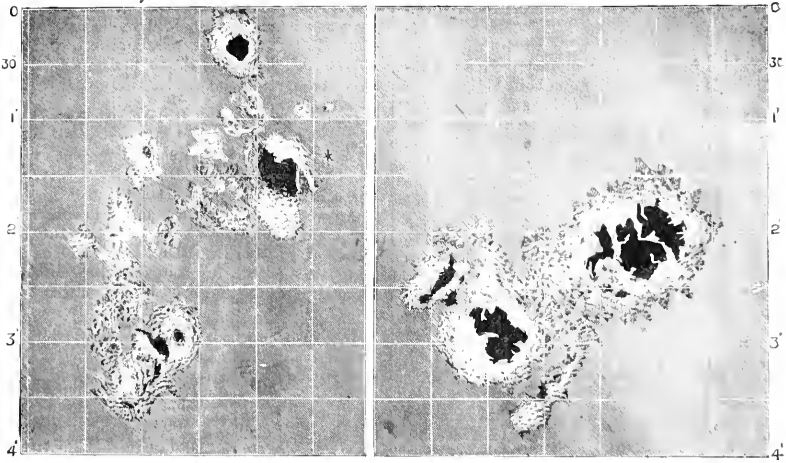
June 25, 1883. June 29, 1883.

δ 7h. 45m. A.M. γ 7h. 35m. A.M. δ 9h. 0m. A.M.



June 29, 1883. June 30, 1883.

γ 8h. 10m. A.M. δ 8h. 5m. A.M.



* Notice above the absence of the usual sharp distinction between Umbra and Penumbra.

VAST SUN-SPOTS.

THE Rev. Mr. F. Howlett, whose skill and success in drawing spots, shown by the method of projection described in last week's Knowledge, is well known, has favoured the editor with photographs of the great spots visible in April and November, 1882, and in June, 1883; also of the Transit of Venus, December, 1882. From his photographs the accompanying engravings have been made.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. VI.—BREAD-MAKING (Continued).

THE fact that there is such a thing as bad bread comes home to us at times in too pertinent a fashion to permit of any doubt of its existence. Since writing the last of these articles, I have eaten, during a stay in Liverpool, some of the best bread I ever tasted—an article far

superior to any bread I have ever obtained in the South. The particular bread referred to was obtained from an ordinary baker's shop, and was light, white, of most delicious flavour, and even after keeping some days, showed not the slightest taste or smell of acidity. Without a greater knowledge of local facts, it is difficult to give the reasons for this superiority. Without doubt, in the first place, the baker must be a master of his trade. But in addition to this, flour of the best quality must be used; it is possible that Liverpool, being one of the principal English ports to which flour and grain are shipped, and these from some of the best wheat-growing countries, that better flour can be there obtained for the same price as that asked for an inferior quality where an additional charge for carriage is incurred. Be this as it may, for reasons laid down in our last article, good flour is an indispensable requisite for the production of good bread. Unfortunately nature, in yielding us the fruits of the earth, does not always yield them in the best possible condition; rain and want of adequate sunshine may cause the wheat crop to be poor and the grain damp and not thoroughly ripened. Under these adverse circumstances the problem to be faced is how to make the best bread possible from the unsound flour obtainable. The great difficulty with such flour is the tendency of the gluten to convert the starch into sugar; there is further the danger of lactic fermentation and consequent sourness.

Certain mineral substances possess the power of arresting the action of the gluten of damp flour on its starch; among these alum has been long employed by the bakers. Alum is a double sulphate of alumina and potash, having the formula $Al_2K_2(SO_4)_4$. A flour which, under ordinary circumstances, produces a bread unfit for consumption can be made by the addition of a small quantity of alum to yield a white bread of fair quality. If an infusion of bran be made and added to some boiled starch, the starch is rapidly converted into dextrin and sugar, and the mixture gives no colouration with iodine tincture; but if to a second quantity of boiled starch a little alum is added before the infusion of bran, the conversion is either altogether stopped or proceeds very slowly. In the same way the alum prevents the decomposition of starch in the operation of bread-making. It is also claimed for alum that it prevents bread becoming sour or mouldy. Both these changes, in common with ordinary fermentation, are produced by the growth of organisms, and the action of alum may be explained by stating that its presence is injurious to these bodies; that it is, in fact, to them, a poison. Hence alum also tends to prevent fermentation proper (or alcoholic fermentation), but its presence is not so inimical to these particular germs as to those producing lactic acid and ordinary mould. So far we have been dealing with the advantages resulting from the use of alum; and there is no doubt that in many ways its action is beneficial. There is, however, another side to this question, and that relates to the consequences resulting from a continual absorption into the system of alum, even in small quantities. Opinion is here divided, but an undoubted result is the production of constipation and the symptoms of ill-health following in its train. It acts in yet another manner; in very much the same fashion as it prevents the decomposition of starch during the time the bread is "put to soak," so, too, it tends to retard the digestive action of the fluids of the stomach on the bread; much of the nutriment contained in the flour being thereby wasted. It has also been asserted that bread which has been alumed retains a much larger quantity of water than it otherwise would do. Chemical analysis does not, however, bear out this statement, for on examination some alumed loaves were found to contain 43·68, and others without alum 42·78 per cent. of water. This difference is less than the variation between the limits of percentage of water in loaves of the one class only.

Other substances are or have been suggested as substitutes for alum. Among these, the least injurious is lime-water. This substance is stated to be equally efficacious in preventing the decomposition of starch; while, as the yeast fermentation proceeds, the carbon dioxide gas that is evolved combines with the lime and produces chalk (carbonate of lime), a substance having but little action on the organs of digestion. Among other proposed substitutes for alum, sulphate of copper is said to have been used. This body is so poisonous that its employment in even the smallest quantities is extremely reprehensible.

Hitherto, the only means considered for the production of carbon dioxide within the bread has been the use of yeast or leaven for the purpose of causing fermentation. The employment of alum and other substances of similar properties is simply to prevent injurious changes proceeding simultaneously with the fermentation, unsound flour being particularly liable to such alteration.

Although it is still almost universally the custom for dough to be raised by the use of yeast or leaven, there have been from time to time other methods devised than that which depends on the production of carbon dioxide gas by the decomposition of a part of the flour itself. Among these other methods the use of "baking powder" is the best known. This substance consists essentially of bicarbonate of soda and tartaric acid. If a pinch of the powder is put into some water, the same reaction takes place as when water is added to "sherbet" or "citrate of magnesia." All these mixtures contain the two bodies above-mentioned, and when moistened the tartaric acid immediately combines with the soda and liberates the carbon dioxide:—

$$\underset{\text{Tartaric acid.}}{H_2C_4H_4O_6} + \underset{\text{Bicarbonate of soda.}}{2NaHCO_3} = \underset{\text{Tartrate of soda.}}{Na_2C_4H_4O_6} + 2H_2O + \underset{\text{Carbon Dioxide.}}{2CO_2}$$

The baking powder in making bread is mixed with the *dry* flour, which is then made into a dough with water, cut into loaves and then baked in a quick oven. The bicarbonate of soda is sometimes used alone, as the heat of the oven is competent to effect its decomposition into normal carbonate of soda and carbon dioxide thus:—

$$\underset{\text{Bicarbonate of soda.}}{2NaHCO_3} = \underset{\text{Normal Carbonate of soda.}}{Na_2CO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + H_2O$$

Although not strictly connected with our present subject, it may be of service to mention, in passing, the difference between the bicarbonate and normal carbonate of soda. The above formulæ show that the carbonate contains twice as much sodium. Carbonic acid, H_2CO_3, contains two atoms of hydrogen, which require two atoms of sodium in order to displace them; when only the one atom is displaced, a bi- or half- salt is formed. Carbonate of soda is but little used for domestic purposes, as it is more powerfully alkaline and exerts an injurious action on the coats of the stomach.

Our next article will deal specially with the properties of aërated bread.

Life of the Edison Lamp.—It is stated, says the *Electrician*, that some Edison lamps in a mill at Philadelphia have lasted on an average 3,886 hours, and are still going.

POKER PRINCIPLES.

THE following specimen of American humour will amuse our readers:—

"It is a long way from the stars to poker," says the *Chicago Tribune*, "but Richard A. Proctor has made the jump, and in the September number of *Longman's Magazine* he discusses learnedly the topic, 'Poker Principles and Chance Laws.' It might be expected of a man whose turn of mind is scientific, who reasons on hard facts and cold deductions, that he would treat even a game of poker in the same cold, calculating manner, and Mr. Proctor does this. After describing the game, for it is not yet fairly acclimatised in England, he calculates in a cold-blooded manner the chances for each different hand at poker. He finds that the total number of poker hands is 2,598,960. He then enters into an exact mathematical calculation, and finds that in these hands there may be 40 flush sequences, 624 fours, 3,744 full hands, 5,108 common flushes, 10,200 common sequences, 54,912 triplets, 123,552 two pairs, 1,098,240 pairs, and 1,302,540 other hands. With these data for starting points, he devotes page after page to abstruse calculations of chances on given hands, and finally winds up by saying that 'poker-playing generally, as a process for making money more quickly, is much improved and enlivened by a slight degree of intoxication'—a condition which seems highly problematical if the player is expected to remember the involved mathematical processes which he lays down, and certainly implies a moral laxity which makes one shudder at the mere thought. If Professor Proctor really believes that intoxication is an aid in perfecting and applying mathematical deduction, it is easy to understand why he has so often slipped up in his celestial mathematics." [My Chicagoan friend should have shown when and where; since, however, the remark about intoxication was not mine, but was made by an American writer on Poker Principles, the Chicagoan's vague idea about errors in my calculations may be taken for what it is worth —nothing.—R. P.]

"The most startling feature of Prof. Proctor's discussion is the manner in which he treats bluffing. He gravely recommends intoxication as a prime condition for playing a good or poor hand, and regards it as mathematically moral—but 'bluffing should be omitted, as practice in this department of the game is really practice in the art of lying with unchanging face, and this is an undesirable art, whatever rogues may think. The gain which can be made by skill in lying is more than matched by the loss which a reputation for such skill is sure to bring.' This, it need not be said, is a narrow English view of a purely American institution. It is not poker as Minister Schenck taught it to the court and people to which he was accredited—a boon which has made his name famous in the annals of diplomacy. It is not the kind of game played by Clay and Webster, which Mr. Proctor cites, in which after each had $2,000 on the board, Clay called Webster on an ace-high, and found his opponent had a pair of deuces, in commenting upon which the astronomer learnedly says: 'The strange part of the story is that Clay should have called, for, apart from any question whether Webster were bluffing or not, ace-high is not a hand on which to call.' Mr. Proctor will never induce those who have once come under the fascination of the game to avoid bluffing. To play the game on such a condition involves about the same degree of thrilling interest one would experience in sitting down to calculate a table of logarithms or to work out an endless length of sines and cosines."

"Unwittingly, perhaps, he has stripped the game of all that has made it so dear to the American heart. By his methods it loses all its airiness of contour, its mysterious glamour of illusion, its dashing assaults, its leadings of forlorn hopes, its thrilling surprises, its ruthless blights of expectation, its oscillations from hope to defeat, and is reduced to a mere dry, hard, cold mathematical computation, which is not even mitigated by his recommendation that the players get intoxicated. It plucks the very heart out of the game, and slaughters the mystical sphinx whose riddle at poker no man has ever yet read. If a full hand must always be beaten by fours, or two pairs by a triplet, what inducement is there to play poker? Better casino and old maid than this game emasculated of that mysterious, subtle, always-appearing-when-least-expected quality which makes it possible for a jack high to sweep the board against three kings or an ace full. No! Mr. Astronomer. Poker knows no laws and spurns all conditions. The man is its measure, and he who has the genuine poker afflatus, though he were a clown and had but a pair of deuces, would be dangerous to Mr. Proctor with a straight flush, even were he to follow his own recommendation and get as drunk as a lord. Let Mr. Proctor take his heaps of calculations and come into these Western wilds, if he wants to know the legions of possibilities that lurk in this noble game."

[As I never took a hand at poker and am not likely to, the legions of possibilities in poker will for ever remain unknown to me, except as indicated by mathematics.—R. P.]

The American Telegraph System.—A correspondent of the *Daily Telegraph* recently wired as follows from Washington:—"The Committee of the United States Senate appointed to inquire into the American telegraph system and the advisability of its acquirement by the State on the English plan met to day. The principal witness examined was Mr. Jay Gould, the eminent financier and president of the Western Union Telegraph Company, who emphatically denounced the scheme for placing the telegraphs under the control of the Government. He affirmed that Government telegraphs must always be inefficient, unstable, and subject to political influence."

Anthracene and Light.—The substance known as anthracene has been found by Dr. Tommasi to possess a new property, namely, a sensitiveness to light, which will doubtless prove of value. Anthracene on exposure to light acquires different physical and chemical properties without any change in its composition. If a cold clear saturated solution of anthracene in benzol is exposed to the direct rays of the sun, it becomes turbid and deposits crystals, which have received the name of paranthracene.—*Engineering*.

A new mountain railway—Territet Montreux-Glion—has been constructed on the shores of the Lake of Geneva. No locomotive is used, but the weight of the descending carriage is used to bring the ascending vehicle up the incline. The necessary increase of weight required is provided for by water ballast. The line is only about 750 yards long, and the height attained is 327 yards above the spot where the railway commences. The lower portion of the line has a gradient of 300 in 1,000, and the upper portion 570 in 1,000. An automatic brake has been provided, which acts in case a breakage of the rope takes place. The carriages are specially built in consideration of the gradients referred to, and are constructed to hold twenty persons each.—*Engineer*.

THE PHILOSOPHY OF MATHEMATICS.*

By Professor A. Cayley.

IN TWO PARTS.—PART I.

MATHEMATICS connect themselves on the one side with common life and the physical sciences; on the other side, with philosophy, in regard to our notions of space and time, and in the questions which have arisen as to the universality and necessity of the truths of mathematics and the foundation of our knowledge of them.

As to the former side, I am not making before you a defence of mathematics. Still less would I speak of its utility before, I trust, a friendly audience, interested or willing to appreciate an interest in mathematics in itself and for its own sake.

On the other side, the general opinion has been, and is, that it is indeed by experience that we arrive at the truths of mathematics, but that experience is not their proper foundation; the mind itself contributes something. But it is maintained by John Stuart Mill that the truths of mathematics, in particular those of geometry, rest on experience;† and, as regards geometry, the same view is on very different grounds maintained by the mathematician Riemann.

I think it may be at once conceded that the truths of geometry are truths precisely because they relate to and express the properties of what Mill calls "purely imaginary objects." That these objects do not exist in Mill's sense, that they do not exist in nature, may also be granted; that they are "not even possible," if this means not possible in an existing nature, may also be granted. That we cannot "conceive" them depends on the meaning which we attach to the word conceive. I would myself say that the purely imaginary objects are the only realities, the ὄντως ὄντα, in regard to which the corresponding physical objects are as the shadows in the cave; and it is only by means of them that we are able to deny the existence of a corresponding physical object. If there is no conception of straightness, then it is meaningless to deny the existence of a perfectly straight line. But, at any rate, the objects of geometrical truth are the so-called imaginary objects of Mill, and the truths of geometry are only true, and *à fortiori* are only necessarily true, in regard to these so-called imaginary objects; and these objects, points, lines, circles, &c., in the mathematical sense of the terms, have a likeness to, and are represented more or less imperfectly, and from a geometer's point of view, no matter how imperfectly, by corresponding physical points, lines, circles, &c.

I shall have to return to geometry, and will then speak of Riemann, but I will first refer to another passage of the "Logic." Speaking of the truths of arithmetic, Mill says (p. 297) that even here there is one hypothetical element:—"In all propositions concerning numbers a condition is implied without which none of them would be true, and that condition is an assumption which may be false. The condition is that $1=1$; that all the numbers are numbers of the same or of equal units." Here, at least the assumption may be absolutely true; one shilling = one shilling in purchasing power, although they may not be absolutely of the same weight and fineness, but it is hardly necessary; one coin + one coin = two coins, even if the one be a shilling and the other a half-crown. In fact, whatever difficulty be raisable as to geometry, it seems to me that no similar difficulty applies to arithmetic; mathematicians or not, we have each of us, in its most abstract form, the idea of a number; we can each of us appreciate the truth of a proposition in regard to numbers, and we cannot but see that a truth in regard to numbers is something different in kind from an experimental truth generalised from experience. Compare, for instance, the proposition that the sun, having already risen so many times, will rise to-morrow, and the next day, and the day after that, and so on, and the proposition that even and odd numbers succeed each other alternately *ad infinitum*, the latter, at least, seems to have the characters of universality and necessity. Or, again, suppose a proposition observed to hold good for a long series of numbers, 1,000 numbers, 2,000 numbers, as the case may be, this is not only no proof, but it is absolutely no evidence, that the proposition is a true proposition holding good for all numbers whatever; there are in

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* Abstract of that portion of Professor Cayley's Address before the British Association at Southport, which relates to the philosophy of Mathematics and to certain recent ideas respecting non-Euclidian Geometry and space of more than three dimensions.

† "It remains to inquire what is the ground of our belief in axioms, what is the evidence on which they rest. I answer, they are experimental truths, generalisations from experience. The proposition 'Two straight lines cannot enclose a space,' or, in other words, two straight lines which have once met cannot meet again, is an induction from the evidence of our senses." But I cannot help considering a previous argument (p. 259) as very materially modifying this absolute contradiction. After inquiring, "Why are mathematics by almost all philosophers . . . considered to be independent of the evidence of experience and observation, and characterised as systems of necessary truth?" Mill proceeds as follows:—"The answer I conceive to be that this character of necessity ascribed to the truths of mathematics, and even (with some reservations to be hereafter made) the peculiar certainty ascribed to them, is a delusion, in order to sustain which it is necessary to suppose that those truths relate to and express the properties of purely imaginary objects. It is acknowledged that the conclusions of geometry are derived partly at least from the so-called definitions, and that these definitions are assumed to be correct representations, as far as they go, of the objects with which geometry is conversant. Now, we have pointed out that from a definition as such, no proposition, unless it be one concerning the meaning of a word, can ever follow, and that what apparently follows from a definition follows in reality from an implied assumption that there exists a real thing conformable thereto. This assumption in the case of the definitions of geometry is not strictly true; there exist no real things exactly conformable to the definitions. There exist no real points without magnitude, no lines without breadth, nor perfectly straight, no circles with all their radii exactly equal, nor squares with all their angles perfectly right. It will be said that the assumption does not extend to the actual but only to the possible existence of such things. I answer that, according to every test we have of possibility, they are not even possible. Their existence, so far as we can form any judgment, would seem to be inconsistent with the physical constitution of our planet at least, if not of the universal (*sic*). To get rid of this difficulty and at the same time to save the credit of the supposed system of necessary truth, it is customary to say that the points, lines, circles, and squares which are the subjects of geometry exist in our conceptions merely, and are parts of our minds, which minds, by working on their own materials, construct an *à priori* science the evidence of which is purely mental and has nothing to do with outward experience. By howsoever high authority this doctrine has been sanctioned, it appears to me psychologically incorrect. The points, lines, and squares which any one has in his mind are (as I apprehend) simply copies of the points, lines, and squares which he has known in his experience. Our idea of a point I apprehend to be simply our idea of the *minimum visible*—the small portion of surface which we can see. We can reason about a line as if it had no breadth because we have a power which we can exercise over the operations of our minds—the power, when perception is present to our senses or a conception to our intellects, of attending to a part only of that perception or conception instead of the whole. But we cannot conceive a line without breadth—we can form no mental picture of such a line; all the lines which we have in our mind are lines possessing breadth. If any one doubts this, we may refer him to his own experience. I much question if any one who fancies that he can conceive of a mathematical line thinks so from the evidence of his own consciousness. I suspect it is rather because he supposes that unless such a perception be possible, mathematics could not exist as a science—a supposition which there will be no difficulty in showing to be groundless."

the Theory of Numbers very remarkable instances of propositions observed to hold good for very long series of numbers, and which are nevertheless untrue.

I pass in review certain mathematical theories. In arithmetic and algebra, or say in analysis, the numbers or magnitudes which we represent by symbols are, in the first instance, ordinary (that is, positive) numbers or magnitudes. We have also in analysis and in analytical geometry negative magnitudes; there has been in regard to these plenty of philosophical discussion, and I might refer to Kant's paper, "Ueber die negativen Grossen in die Weltweisheit" (1763); but the notion of a negative magnitude has become quite a familiar one, and has extended itself into common phraseology. I may remark that it is used in a very refined manner in bookkeeping by double entry.

But it is far otherwise with the notion which is really the fundamental one (and I cannot too strongly emphasize the assertion) underlying and pervading the whole of modern analysis and geometry—that of imaginary magnitude in analysis and of imaginary space (or space as a *locus in quo* of imaginary points and figures) in geometry. I use in each case the word "imaginary" as including real. This has not been, so far as I am aware, a subject of philosophical discussion or inquiry. As regards the older metaphysical writers this would be quite accounted for by saying that they knew nothing, and were not bound to know anything, about it; but at present, and considering the prominent position which the notion occupies, say even that the conclusion were that the notion belongs to mere technical mathematics, or has reference to nonentities in regard to which no science is possible, still it seems to me that (as a subject of philosophical discussion) the notion ought not to be thus ignored; it should at least be shown that there is a right to ignore it.

Although in logical order I should perhaps now speak of the notion just referred to, it will be convenient to speak first of some other quasi-geometrical notions; those of more-than-three-dimensional space, and of non-Euclidian two- and three-dimensional space, and also of the generalised notion of distance. It is in connection with these that Riemann considered that our notion of space is founded on experience, or rather that it is only by experience that we know that our space is Euclidian space. It is well known that Euclid's twelfth axiom, even in Playfair's form of it, has been considered as needing demonstration; and that Lobatschewsky constructed a perfectly consistent theory, wherein this axiom was assumed not to hold good, or say a system of non-Euclidian plane geometry. There is a like system of non-Euclidian solid geometry.

My own view is that Euclid's twelfth axiom in Playfair's form of it does not need demonstration; that it is part of our notion of space, of the physical space of our experience—the space, that is, which we become acquainted with by experience, but which is the representation lying at the foundation of all external experience. Riemann's view before referred to may, I think, be said to be that, having *in intellectu* a more general notion of space—in fact, a notion of non-Eucludian space, we learn by experience that space (the physical space of our experience) is, if not exactly, at least to the highest degree of approximation, Euclidian space. But suppose the physical space of our experience to be thus only approximately Euclidian space, what is the consequence which follows? Not that the propositions of geometry are only approximately true, but that they remain absolutely true in regard to that Euclidian space which has been so long regarded as being the physical space of our experience.

(*Part II. in our next.*)

COMMAS AND COLONS.

THERE is a further argument against the Brighton theory of parenthetic commas round adverbs, which will reveal itself if you merely write instead of "He insulted me, and therefore I went away," "He insulted me, and I went away in consequence," or "therefore." Who would think of putting a comma before "therefore" in that case? And in either position who would think of speaking it *commatically*, which is often, if not always, the best rule for punctuation?

I by no means disregard the distinction between colons and semicolons myself; but I cannot shut my eyes to the fact that much better writers than I am are far from consistent in their use of them; and I cannot find, or hardly imagine, a case where the substitution of one for the other would make any difference in either the real or the apparent sense. On the other hand, cases are constantly occurring where one would like a smaller comma—or a larger one, as the case may be.

I thank you for your protection as to the evidently missing comma in my former letter, which I was sure that some "F. R." would be down upon. His criticism on my ambiguous "it" proves that he is one of those who think that if you can put a wrong or absurd meaning into somebody else's writing the somebody else must have meant it.

Edm. Beckett.

THE FACE OF THE SKY.

From Sept. 28 to Oct. 12.

By F.R.A.S.

THE sun will be examined, as usual, for indications of disturbance on every clear day, and the Zodiacal light may be looked for in the East before sunrise. Map X. of "The Stars in their Seasons," gives a picture of the Night Sky during our prescribed period. Mercury sets after the sun to-night, but comes into inferior conjunction with him on October 7, after which Mercury is a morning star. He is most indifferently placed for the observer. Venus is practically invisible. Mars still souths during the morning hours, but sooner and sooner every night, between the N.E. and the E.N.E. points of the horizon. He still presents the appearance of an exaggerated red star. Jupiter now rises before midnight. He is pretty close to Mars in the sky. No phenomena of his satellites occur at times suited to the ordinary observer during the next fourteen days. Saturn, some 3° or 4° North of Aldebaran, rises soon after 8 p.m., and is getting nightly into a more favourable position for the observer. The remarks which we made a fortnight ago with regard to Uranus and Neptune are still applicable. The moon is 26·9 days old at noon to-day (September 28), and 0·3 days old on October 1; her age being quite evidently 11·3 days at the same hour on October 12. Hence she will be fairly well placed for the observer during a good deal of the time to which these notes refer. No occultations of stars happen during the period which they cover. The moon is in Sextans at noon to-day, re-entering Leo about midnight. She quits this constellation for Virgo about 4 a.m. on the 30th. She occupies until about 2 p.m. on Oct. 3 in crossing Virgo, and at that hour enters Libra, which she takes until between 5 and 6 p.m. on the 5th to traverse. Then she arrives at the narrow northern part of Scorpio, over which she passes before 4 o'clock the next morning. From that hour until nearly midnight on the 7th she is traversing the southern part of Ophiuchus; but she then crosses its boundary into Sagittarius. Her path through the last-named constellation takes her until 11 a.m. on the 10th to describe. About 3 o'clock on the morning of the 4th she crosses into Aquarius. There we leave her.

North American Indians as Railway Navvies.—From fifty to seventy Winnebago Indians are employed on the Omaha Railway as labourers. They are eager to obtain the work, to which they consider they have a claim, and make excellent labourers, doing a better day's work than the Chinese.—*Engineering.*

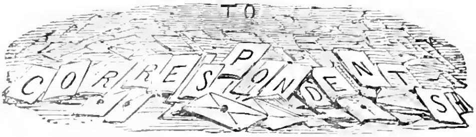
Editorial Gossip.

The British Association meeting makes large claims upon our space this week, and will do so for the next two or three weeks. We propose, when the rest of Professor Cayley's address has appeared, with its amusing references to non-Euclidian space and fourth, fifth, and yet higher dimensions in space, to comment on these conceptions, which certain non-mathematical writers, in their amazement at such profundities, have described in the daily press in terms which would be scarcely justified if applied to Newton's greatest discovery.

In writing my "Gossip" for last week I referred to that part of Sir George Airy's library which he assigned to paradoxists,—Reddie, Parallax, Hampden, *et hoc genus omne*. I was in doubt as to the actual title that he gave to this part of his library, and having written "My Lunatic Asylum," changed the title into "My Asylum for Lunatics," but suppose I failed to delete the first "Lunatic," for the rather tautological title "My Lunatic Asylum for Lunatics" appeared instead of what I intended.

Truth gives me comfort. Several reviewers found my article on Poker Principles in *Longman's Magazine* too abstruse. *Truth* says it only shows that two and two make four. Yet *Truth* condescends to borrow my table of poker hands as "curious." As a considerable part of the article is occupied with the reasoning by which the table was established, this is rather incongruous on Mr. Labouchere's part. Perhaps he objected to some remarks of mine on the Bishop-Labouchere row,—in which, however, I take no manner of interest personally. I only objected to a writer, whose authority on actors and princes and dukes and actresses and circuses may very likely be high, undertaking to define the limits of mental influence, where men like Dr. Carpenter and Professor Barrett have been unable to formulate an opinion.

He goes on to ridicule my remark that "bluffing" at Poker is not desirable,—he makes me say "immoral" which is unnecessary,—because "the gain which can be made by skill in lying is more than matched by the loss which reputation for such skill is sure to bring." "This is about as ridiculous," he says, "as [it would be] to suggest that whist should be played without even finessing because it is a deception practised upon the adversary." My critic appears to confound "finessing" with "underplay,"—a very different thing. For in the great majority of cases, "finessing" is not a deception practised upon the adversary; "underplay" is. However, his argument is not affected by his blunder. But no one would think of regarding "underplay" as wrong, any more than he would regard feints in fencing or single-stick as immoral. Bluffing which is lying for money is a different kind of trick altogether; yet not immoral if gross and greedy gambling is not immoral. But my point was the inexpediency of frequent bluffing, regarded with direct reference to the game itself. To be effective, bluffing should only be resorted to occasionally. As to the expediency of "underplay," Clay has spoken pretty strongly, objecting to it for the very reason indicated by myself in regard to bluffing, that in the long run it does not pay. Probably Clay knew as much about whist as Mr. Labouchere: at any rate I do not find that Clay ever confounded "finessing" with "underplay" (excepting in reference to those special cases where a finesse involves underplay).



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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HIGH WHEELED TRICYCLES *v.* LOW WHEELS.

[938]—In spite of what Mr. Browning says further in last week's Knowledge upon this question, I still hold the conviction that high wheels, *i.e.*, wheels of 50 in. diameter, and when geared up ranging down to say 46 in. with ordinary machines must, and do, give better results as regards general ease of propulsion, and easily acquired and maintained speed, than wheels of the diminutive size he advocates.

It must be remembered that Mr. Browning says he now rides a 38-in. wheeled tricycle, and proposes to have a 36-in. wheel next year.

There are, I venture to say, very few practical riders of any powers that will not agree with me that so small a wheel is a mistake.

In the first place the pedalling must be very rapid to get up any speed at all, and there is a limit to gearing up.

Mr. Browning quotes Mr. Nixon as one of his supporters, but I believe I am right in stating that Mr. Nixon rides machines of 48-in. wheels.

At any rate, I should be very glad to "take him on" if he will ride a machine with 36-in., or even 38-in. wheels of any ordinary pattern. I should then prefer to have a muddy or rough Macadam road, and although Mr. Nixon is undoubtedly a more highly-trained rider than I should ever take the trouble to be, I have very little fear of the result. I should ride my 50-in. Imperial Club light roadster that I have now ridden over 3,000 miles, geared up to 60 inches.

I should bar the "Humber," which is for some reason an exception, but even the "Humber" will, not, I imagine, produce such good results if the wheels fall below, say, 42 in.

Mr. Marriott, who is a remarkable rider, is said to have ridden a 40-in. in the recent fifty miles championship. He did not, however, make such fast time as Lowndes did last year with 48-in. wheels.

At hill-riding, I am satisfied that small wheels are at a decided disadvantage, and as I live at the foot of Muswell-hill, I am in a good position to speak from practical experience. I have ridden this hill from bottom to top without stopping, in all over 50 times, and always with a 50-in. or 52-in. wheeled machine. I once tried hard with a 44-in. machine, but could not get up, but directly afterwards I mounted the hill with a machine of exactly the same make —a Cheylesmore—weighing about the same, with 52-in. wheels. I believe the reason for this is that the small wheels have to go round so much more frequently that the influence of the dead point comes in so often as to impede progression.

I have now in my stable a Sociable with 40-in. wheels, and the riding of this machine, although it is geared up to 47 in., is torture as compared with my 50-in. geared up to 60 in. It is harder work, even with a strong rider in company, and to get up a pace equal to that I can keep up without effort on the 50-in., the pedalling has to be so fast as soon to become fatiguing. It is only by dint of very rapid pedalling that a speed of some eight miles an hour can be attained, while with the 50-in., very slow, easy pedalling will achieve this very moderate pace.

I have recently been riding an "Otto" with 56-in. wheels, and the roll of these big wheels was truly delightful, carrying one over the rough roads without noticing the loose places. An "Otto" with 60-in. wheels, geared level, was ridden up Muswell Hill the other

day, and I will venture to say that it would be a task of no little difficulty to get a 36-in. or 38-in. wheeled geared-up machine up this gradient.

Exceptionally small wheels may do very well on the smooth cinder racing-track, but they will certainly not answer so well as reasonably high wheels for ordinary road riding.

I should like to see two men of equal powers who have never been on a tricycle mounted—the one on Mr. Browning's pet machine, and the other on my pet machine—and I would "bet my bottom dollar" on the result, but for the fact that I never bet at all.

Fancy the appearance of a tall man on a very small Shetland pony! *Verb. sat. sap.!* Sigma.

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[939]—As one deriving much enjoyment in the use of the tricycle, permit me to say that I think the advocates for high, as also for low wheels, are endeavouring to prove too much. As with horses, so with tricycles, there is no particular height suited to every weight and build of rider. There is much room for the exercise of judgment in the matter of height of wheel and kind of machine suited to each individual rider.

There are, however, a few simple rules which may, and certainly should, be applied to the selection and use of tricycles, whether of high or low wheels.

(1) To economise power it is essential that the saddle-seats, being only suited to invalids, should be well over, or even somewhat in advance of the pedals.

(2) The centre of gravity should be as low as possible. This is obtained by fixing the pedals as near the ground as may be sufficient to clear inequalities and loose stones on the surface of the road. I find 4 in. sufficient clearance.

(3) The weight should be pretty evenly distributed on all the wheels.

I could add to the list, but I spare you, and with the foregoing secured the novice would be started on the right "track," and would soon learn to ride with ease and elegance—both at present conspicuously absent from the great majority of tricycle riders.

W. H. France.

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[940]—It has been with interest that I have read these articles, especially as they seem to have been written for people like myself, who are far from strong. To those who object to small wheels and have not the power to propel the large ones up hill, I would recommend the omnicycle. Its wheels are 50 in. It has three gears. Speed for ordinary work, medium for rough or heavy roads, and power for up-hill work; balance gear and free running wheels, both of which are an immense blessing. It runs smoothly and evenly, and, being a lever action, it has no dead points and can be started with ease, even half way up a hill. I run mine in hilly country, and find it everything that can be desired.

John Alex. Ollard.

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[941]—"Sigma's" article on tricycles, in No. 98 of Knowledge, is valuable, as recording the opinion of a rider—and one of our best riders too—of a 50 in. wheeled tricycle geared up to 60 in. But has "Sigma" ever *thoroughly tried* a small wheel (say 40 in.) geared up to the same figure? I fancy not.

One paragraph of the article under question would almost lead any one who did not know the writer to imagine that he was not a rider at all. I refer to where he says: "Nothing wearies so much as rapid pedalling, and nothing looks so ungraceful; and it is obvious that with small wheels the pedalling must be very rapid indeed to get any pace at all." Now, even the greatest novice at tricycling knows that a small wheel can be geared up to any size, and that, consequently, the feet revolve slower proportionately as the size increases.

For myself, I very much prefer a small wheel, and this after experience with eleven or twelve machines, varying in size from 54 inches to 40 inches, geared in different ways. My present mount—a 40-inch "Shadow," geared to 52 inches, and weighing only 46 lb.—I ride *with ease with* $4\frac{1}{2}$*-inch cranks*, the usual length of a tricycle crank being $5\frac{1}{2}$ inches.

The advocates of large wheels talk about the loss of power and bumping on bad macadam roads which the riders of small wheels have to put up with, but it is my experience that for every mile of bad—*really bad*—road met with in the course of a year, I get hundreds of miles of good road, so we don't lose much there.

I believe I am right in saying that Mr. Browning does not attempt to advise on machines for racing men, but for those who ride for *pleasure*, and wish to do their forty or fifty miles a day with comfort and ease; hence his advice to gear low.

Thanking you for opening your valuable columns for the discussion of the construction of the "Coming Tricycle," I am, &c.,

S. H. R. Salmon,
Hon. Sec. London Tricycle Club, T.U.

THE "SUN AND PLANET" BICYCLE.

[942]—In reply to Mr. Browning, my machine weighs 45 lb. exactly. It is heavier than it should be, the forks and backbone being very wide. But I suppose, as the difference in weight of bicycles can only amount to a few pounds, it does not affect the speed much, as it must with tricycles when it comes to 30 lb. or so. I find the machine goes much easier than the Cheylesmore and other tricycles I have been in the habit of riding. I get a beautiful pace out of it, and it is curious that the slow motion of the seat made me feel at first that I *must* be on a "50-inch"—this was rather unpleasant until I overcame the illusion.

When dangers thicken around you, on a small machine nothing is easier than to drop back at once to the ground, in a position of perfect safety, and ready to run the machine anywhere. This could not be done with a tricycle.

The machines are very neat and well made—like engine work—and I can recommend them as the farthest advance I know of in the direction of speed and safety.

Really the fallacies in "Sigma's" remarks seem too plain to need pointing out, but one is that he seems to have an idea Mr. Browning is speaking of *geared-up* wheels. S. J.

NAKED-EYE SUN-SPOT.

[943]—Once more I take up my pen to record the appearance of another spot on the sun, so large as to be easily visible to the naked eye.

The first time I saw it in that way was on Wednesday evening last, September 12, when the sun was setting like a great ball of copper through the mist of the horizon, the spot being very distinct, situated a little below the centre of the disc; and each day since then I have seen it several times through smoked glass.

It is a spot that I first saw with my telescope on Saturday last, September 8, when it was just coming on at the eastern edge of the sun's disc, and consequently appeared very much elongated and foreshortened, and, as far as I could then judge, it was only one spot, but on examining it again with the telescope yesterday, I found it was really composed of two almost entirely distinct spots, of about equal size, placed so close together that the extreme edges of their penumbras at one point appeared to just touch each other. Each spot individually is very large, and so taken together they constitute a tremendous disturbance; and then there are several other smaller spots scattered about the sun's disc, so that I think we may safely say that there is some very great agitation going on there again now, as there has been so many times during the last twelve months. Excelsior.

A CURIOUS PHENOMENON.

[944]—The remarkable phenomenon which Mr. Noble described in No. 98 of Knowledge was also witnessed by me in Liverpool on Aug. 29, at 12 h. 40 m. a.m. I had just been looking at Saturn, when, for the first time, I saw a bright divergent cone of light about 7° above the horizon; the entire length of the cone was about 5°. The apex or nucleus displayed such a degree of concentration that I thought it was the planet Jupiter. I turned my telescope, a 2-inch, armed with a power of 30, on the point where the apex should be (it was now obscured by a cloud), with the expectation of being able to unravel the mystery, but was disappointed, as the cloud was too dense. I then ran my telescope along the major axis of the cone, and the field of view was so faintly illuminated that the brightest part could hardly be said to equal the *lumière cendrée* seen under similar conditions. It gradually faded from view, after having been visible for thirteen minutes. I continued watching the part of the heavens where it had disappeared, with the confident hope that it would return, but was at last obliged to give it up, as a great bank of clouds precluded all further observation.

It could hardly have been an auroral streamer, as the point where it appeared is 67° east of North. W. K. Bradgate.

Sept. 15.

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[945]—The phenomenon seen by Captain Noble may have been the inverted cone of light proceeding from an ironfounders' cupola, visible in slight haze. A line drawn from the observatory in an E.N.E. direction passes nearly through Ashford, in Kent. I do not know that place, but my map of Kent shows it to be an important railway junction, with an "engine depôt." It is probable that at such a place there is a cupola, and that melting might be going on as late as 10.35 p.m. The light is intensely brilliant during the latter part of the operation of melting, when the white-hot metal or slag is left at the bottom of the furnace, and might, I think, be seen, under favourable circumstances, as far off as Ashford (twenty-six miles). That it was a distant object is evident from the sketch. Various causes might account for the sudden extinction.

J. M. Coates.

THE "HUMBLE SOLDIERS."

[946]—May I (perhaps in atonement, being one of the "point-pepperers") give what seems to me to be a good reason for the elimination of the commas in the sentence, "He called for help; and, therefore, I went to him."

I would submit to the writer in the *Brighton Herald* that the word "therefore" is here used as equivalent in sense to the words "that was why," or "for that reason;" and surely he would not insert the commas in either of the following sentences:—

"He called for help; and *that was why* I went to him."

"He called for help; and *for that reason* I went to him."

Compositor.

LETTERS RECEIVED, AND SHORT ANSWERS.

F. M. Diplock. I do not see, either, that the comma is out of place. But it is well to note that the word "Why," in the sentence, is not a question *per se*, as many imagine.—W. B. All the planets turn the same way round as the sun does, except Uranus, and probably Neptune. This way round is that also in which they all, without any exception at all, travel round the sun.—W. O. Dawson. Article in type.—W. Lawrence. If Mr. John Hampden had dictated your letter you could not more completely have caught his style. Permit me to congratulate you. I thought him unique: now I see I was mistaken. If I have "failed to convince a single individual who was in doubt about it" ("it" being the earth's rotundity) I have failed in what I have never attempted to do. Mr. Browning makes excellent spectacles, but he has failed to make a single individual see who chanced to be born blind. (He has not tried, that I am aware, but that only makes the parable better; for neither have I tried to make those see with the mental eye who are mentally blind.)—A. M. Those passages are given in a little volume, published by Messrs. Appleton, New York, containing the speeches (made and not made) at the dinner given in honour of Mr. Herbert Spencer's visit to America. By the way, I am inclined to wonder what would be Mr. Spencer's deliberate opinion on the subject of dinner-giving as a way of indicating esteem and admiration.—D. C. S. (1.) Probably a harmless, but still more probably a useless recipe. You would have to buy of the person who seems so generously to offer the recipe. Note his prices, and recognise rascality. (2.) Yes; smoke-abatement an important subject; *ex fumo dare lucem*—if it could but be managed.—Senex (1.) Not that "silent lightning" is never seen in daytime, but why it is not so often seen in daytime as at night (your note on this subject slightly shortened, will appear). (2.) One cannot directly compare the intensity of waves of light, sound, and water. (3.) Reflection of rainbow can be seen.—Cosmos. Neither the longitude of perihelion nor the inclination of major axis is assumed. The initial assumptions are at once less simple and more tentative. The subject is one for an article, not for a Short Answer.—J. W. Wilson. If we were certain the mass of the two stars together equalled the mass of the sun and earth, we could infer from the period of revolution the precise distance. But in every case yet dealt with we have either had no such knowledge, or have known that the case is quite otherwise. In my "Other Worlds than Ours" the points involved in the problem are fully discussed.—E. T. L. The papers on the Moon began with Vol. III., and the reference map appeared with the first of them.—W. S. Boscawen. I do not know where the rising and setting of stars visible in Babylonia as early as 2,000 B.C. can be obtained. In my library star atlas, and in the maps of my gnomonic atlas, are the longitude and latitude lines, by which correction can be made in the case of any star, for the effects of precession. The star must be carried westwards along its latitude parallel at the rate of 5° for about 359 years of past time. This serves for the vernal equinox also.—M. J. Harding. I am sorry more copies of the Index were not printed. But a copy was sent to every subscriber (as distinguished from buyers). I myself much prefer the plan of issuing the index with the paper. But the publishers saw reasons for adopting a different plan.—D. E. Samuel. The nasal twang of the true Yankee or New Englander has been derived from Puritan ancestors. The Roundheads so spoke. But chronic catarrh may now have something to do with the matter.—E. S. B. Thanks for kind letter. Hints noted. With regard to the "sneak" as you justly call him referred to in article on "Social Dynamite," I have never been in doubt who he was, since Mr. Lockyer disclaimed all knowledge of the matter. I have no doubt either, that after reading what I there wrote, Mr. Lockyer himself could form a tolerably shrewd guess on the subject. He has not however thanked me yet for enabling him to see what a treacherous "friend" that particular person was.—E. F. T. *La Nature* might suit you.—M. C. I think the flat earth folk would deny the validity of the spirit-level proof.—W. G. Knowles. Read Darwin's book on "Mould and Worms."—George Jordan. Cannot further try to explain matters to one unfamiliar with even the elements of science. Have already given to you much more time and attention than you could expect.—W. W. F. The whole column of water. H. Askew. (1) Some nonsense about the holy numbers three and seven. I forget what. (2). It is difficult to get in all desirable subjects.—J. G. Fisher. The printers arrange that matter of month, day, year. Your letter sent to printers.

Inquirer. If you will state in a letter the rules for the four possible cases, will publish: but a single case out of four would only perplex readers.—T. Maude. There are differences of atmospheric pressure in different latitudes, and these differences obviously depend on latitude; but they are certainly not proportional to the rate of terrestrial rotation. The pressure and density are greatest in the sub-tropical zones.—W. B. No one would think of extracting square root by logarithms, when only two or three digits are wanted.—Uncertain. I fear those metaphysical speculations would have no interest for readers. As to your swearing, *I* can have no manner of objection. It may be as you suggest, "an unco' relief to a body." I fancy it is like dram-drinking though, and that the round oath which relieves your feelings now will require to be replaced by a stronger one hereafter. My own personal objection to swearing is that no matter what form of oath one adopts, one becomes conscious of temporary misuse of reason in employing it. Whether you swear by "thunder," or wish you may be "dad-slapped," or call what offends you a "dodgasted" noun of some sort, or prefer something more genuinely profane, comes to much the same; there is idiocy in the thing, in every aspect of it.

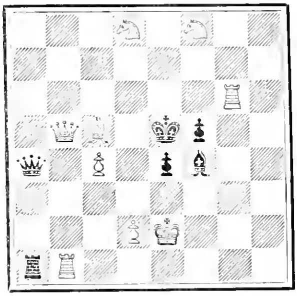
Our Chess Column.

By Mephisto.

PROBLEM No. 100.

By G. Woodcock.

Black.



White.

White to play and self-mate in five moves.

SOLUTIONS.

Problem No. 97, by C. Planck, p. 176.

1. Q to Kt4

If K to B6, Kt to K2 mate. K to B4, Kt to Q3 mate. K to K4, Kt to R5 mate. K to K6, Kt to Kt2 mate. P to B4, Kt takes P mate. B moves, Kt to K6 mate.

No. 98, by J. C. S., p. 176.

1. R to Q sq.	K moves, or		B to Kt4
2. B to QKt4 (ch)	K to K4	2. B to Kt4 (ch)	Kt takes B
3. Kt to B4 mate.		3. P to B4 mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. R. Edwards.—In Problem 97, if 1. Kt to Q3, K to B6, and there is no mate next move.

Correct solutions received, Problem 97, Berrow, John Watson, B. Gleam, M. T. Hooton. No. 98, John Watson. No. 99, Berrow, W., H. Seward.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

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Contents of No. 101.

BRITISH ASSOCIATION SCRAPS.

N a paper read before the Mathematical and Physical section, Professor Chandler Roberts remarked on the rapid diffusion of molten metals. The two metals chosen were lead and gold enclosed in a U-shaped tube, the lead occupying the lower portion of the tube, and the gold being put in at the top of one limb. After about forty minutes Professor Roberts found that the two metals had been thoroughly mixed. Sir W. Thomson called attention to the extreme importance of this, with reference to metallic alloys, and remarked that it resembled the diffusion of gases or of heat in a gas rather than of a solid in a liquid. Salt would take years to diffuse in a similar manner through water.

A paper was read which had been received from two American gentlemen, Messrs. W. B. Scott and H. F. Osborne, upon the "Origin and Development of the Rhinoceros Group." These gentlemen have made careful researches in the extensive series of tertiary lake deposits in the North-Western United States, in which specimens of very many animals have been discovered, which render it possible satisfactorily to trace the genealogy of several important groups of mammals. These gentlemen have discovered the remains of the ancestor of the rhinoceros group—an ancestry from which it is found that both the rhinoceros and the tapir groups are descended. This animal has been named Orthocynodon. A somewhat detailed account of the anatomy of the skull and form of dentition was given, bearing out the authors' views.

The committee on Meteoric Dust state that Mr. Pope Hennessy had obtained a quantity of ice and snow from the Himalayas. After being melted and boiled down the residue was sent to England for examination. In most specimens of the dust are a number of small spherical bodies of magnetic matter, the surfaces of which are generally highly polished. Dr. Schuster showed several of these particles, the largest being perhaps one-twentieth of a millimètre in diameter, which had been obtained from a spot in the Himalayas about 3,400 ft. high and 14 miles from any human habitation.

Sir R. W. Rawson stated that, according to the observations of the Anthropometric Committee, it appeared that from the top of the social scale to the bottom there was a gradual descent in stature, weight, chest-girth, and all the elements of strength. It was therefore of the utmost importance that by nurture and improvement of sanitary conditions the lowest should be raised to the level of the highest.

Dr. Schuster read an interesting paper on the motion of the Swiss glaciers. It has been known for some time that there are long periods of time during which the Swiss glaciers advance down or recede up their beds. Thus, in 1741, they were advancing, but it was reported that in 1700 it was possible to walk from Chamounix to Courmeyer over the Col de Géant without touching ice. They advanced all last century as far as is known and up to 1817, then went back until 1840, advanced till 1859, and have since been receding till the present year, when many, including the Mer de Glace and the Rosenlaui glacier, have begun to advance. Dr. Schuster has made observations this summer on the Glacier des Boissons, at Chamounix, and has arrived at the important conclusion that the rate of motion of the same point on a glacier changes greatly from day to day. Thus he showed that while during the day the hourly rate of motion of one point observed was only ·6 centimètres, during the next night it advanced at the rate of 5·5 centimètres per hour. The rate of other points examined varied, but not so greatly. Dr. Schuster also noticed the change occurring at the foot of the glacier when it comes into the valley. The downward motion of this point is determined by the fact that the parts above advance more quickly than the ice at the foot melts away. He found that on one side of the glacier, where it rested against a boulder, there was no apparent change in the outline of the ice or in the position of the boulder during the day, while at the other side the end had moved in the same time four or five feet.

A paper was read by Mr. E. B. Poulton on heredity in cats with an abnormal number of toes. The peculiarity appeared in the third generation and in succeeding generations. All varieties between the normal four and the extreme seven toes had been observed. The females most frequently possessed the abnormal number of toes. They were very clever at catching mice, and readily learnt to shake hands. The President said the importance of such observations lay in their bearing on heredity. Reasons had been advanced to show that man was descended from a six-fingered animal. Miss Buckland said she had seen in Bath a cat with seven toes on each foot. Professor Marshall remarked on the importance of such observations in relation to investigations as to the origin of species.

Mr. Adam Sedgwick gave an account of the Periodatus—a slug-like animal which he found in South Africa, and of which he exhibited specimens. The animal, he said, had only recently been discovered, and he made a special visit to the Cape to obtain specimens. Special interest attached to it, as it had no living relations in the animal kingdom. It was a survival of a type of animal which at some ancient time in the world's history was represented by a greater number of forms. The animal lived in the roots of rotten trees, and it had probably survived on account of its habits and the difficulty of finding it. Since its first discovery the animal had been found in New Zealand, South America, and other parts of the world.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XVII.

BEFORE bringing this series of papers to an end, it may be well to give an illustration or two of the survival of myth in historical narrative.

For proofs of the emergence of the higher out of the lower in philosophy and religion, to say nothing of less exalted matters, whether the beast-fable or the nursery rhyme as holding barbaric thought in solution, examples have necessarily been drawn from the mythology of past and present savage races. But these are too remote in time or standpoint to stir other than a languid interest in the reader's mind; their purpose is served when they are cited and classified as specimens. Not thus is it with examples drawn nearer home from sources at which our young thirst for the stirring and romantic was slaked. When we learn that famous names and striking episodes are in some instances only transformed and personified natural phenomena, or, as occurring everywhere, possibly variants of a common legend, the far-reaching influence of primitive thought comes to us in more vivid and exciting form. And although one takes in hand this work of disenchantment in no eager fashion, the loss is more seeming than real. Whether the particular tale of bravery, of selflessness, of faithfulness, has truth of detail, matters little compared with the fact that its reception the wide world over witnesses to human belief, even at low levels, in the qualities which have given man empire over himself and ever raised the moral standard of the race. Moreover, in times like these, when criticism is testing without fear or favour the trustworthiness of records of the past, whether of Jew or Gentile, the knowledge of the legendary origin of events woven into sober history prepares us to recognise how the imagination has fed the stream of tradition, itself no mean tributary of that larger stream of history, the purity of which is now subject of analysis. As a familiar and interesting example let us take the story of William Tell.

Everybody has heard how, in the year 1307 (or, as some say, 1296) Gessler, Vogt (or governor) of the Emperor Albert of Hapsburg, set a hat on a pole as symbol of the Imperial power, and ordered every one who passed by to do obeisance to it; and how a mountaineer named Wilhelm Tell, who hated Gessler and the tyranny which the symbol expressed, passed by without saluting the hat, and was at once seized and brought before Gessler, who ordered that as punishment, Tell should shoot an apple off the head of his own son. As resistance was vain, the apple was placed on the boy's head, when Tell bent his bow, and the arrow, piercing the apple, fell with it to the ground. Gessler saw that Tell, before shooting, had stuck a second arrow in his belt, and, asking the reason, received this for answer: "It was for you; had I shot my child, know that this would have pierced your heart."

Now, this story first occurs in the chronicle of Melchior Russ, who wrote at the end of the fifteenth century, *i.e.*, about one hundred and seventy years after its reputed occurrence. The absence of any reference to it in contemporary records caused doubt to be thrown upon it three centuries ago. Guillimann, the author of a work on Swiss Antiquities, published in 1598, calls it a fable, but subscribes to the current belief in it, because the tale is so popular! The race to which he belonged is not yet extinct. A century and a half later, a more fearless sceptic, who said that the story was of Danish origin, was condemned by the Canton of Uri to be burnt alive, and in the well-timed absence of the offender, his book was ordered to be burnt by the common hangman. But the truth is great, and prevails. G. von Wyss, the Swiss historian, has pointed out that the name of Wilhelm Tell does not occur even once in the history of the three cantons, neither is there any trace that a "Vogt" named Gessler, ever served the house of Hapsburg there. Moreover, the legend does not correspond to any fact of a period of oppression of the Swiss at the hands of their Austrian rulers.

"There exist in contemporary records no instances of wanton outrage and insolence on the Hapsburg side. It was the object of that power to obtain political ascendancy, not to indulge its representatives in lust or wanton insult," and, where records of disputes between particular persons occur, "the symptoms of violence, as is natural enough, appear rather on the side of the Swiss than on that of the aggrandising imperial house."*

Candour, however, requires that the evidence in support of the legend should be stated, although it may have little weight with the readers of Knowledge. There is the fountain on the supposed site of the lime-tree in the market-place at Altdorf by which young Tell stood, as well as the colossal plaster statue of the hero himself which confronts us as we enter the quaint village. But more than this, the veritable cross-bow itself is preserved in the arsenal at Zurich!

However, although the little Tell's chapel, as restored, "was opened with a national *fête*, in the presence of two members of the Federal Council, in June last,"† the Swiss now admit in their school-teaching that the story of the *Apfelschuss* is legendary.

Freudenberger, who earned his death-sentence for affirming that the story came from Denmark, was on the right track, for the following variant of it is given by Saxo Grammaticus, a Danish writer of the twelfth century, who puts it as happening in the year 950:—

"Nor ought what follows to be enveloped in silence. Palnatoki, for some time in the body-guard of King Harold (Harold Gormson, or Bluetooth), had made his bravery odious to many of his fellow-soldiers by the zeal with which he surpassed them. One day, when he had drunk too much, he boasted that he was so skilled a bowman that he could hit the smallest apple, set on the top of a stick some way off, at the first shot, which boast reached the ears of the king. This monarch's wickedness soon turned the confidence of the father to the peril of the son, for he commanded that this dearest pledge of his life should stand in place of the stick, adding a threat that if Palnatoki did not at his first shot strike off the apple, he should with his head pay the penalty of making an empty boast. This command forced him to attempt more than he had promised, and what he *had* said, reported by slanderous tongues, bound him to accomplish what he had *not* said. Yet did not his sterling courage, though caught in the snare of slander, suffer him to lay aside his firmness of heart. As soon as the boy was led forth, Palnatoki warned him to await the speeding of the arrow with calm ears and unbent head, lest by any slight movement of the body, he should frustrate the archer's well-tried skill. He then made him stand with his back toward him, lest he should be scared at the sight of the arrow. Then he drew three arrows from his quiver, and with the first that he fitted to the string he struck the apple. When the king asked him why he had taken more than one arrow from his quiver, when he was to be allowed to make but one trial with his bow, he made answer,

* *Edinburgh Review*, January, 1869, p. 134. Article on Rilliet's "Origines de la Confédération Suisse: Histoire et Légende."

† *Times'* telegram from Geneva, June 25.

"That I might avenge on thee the swerving of the first by the points of the others, lest perchance my innocence might have been punished, while your violence escaped scot-free.'" *

Going further northward we find tales corresponding in their main features to the above, in the Icelandic Saga, the Vilkina; in the Norse Saga of Saint Olaf or Thidrik; and in the story of Harold, son of Sigurd. In the Olaf Saga it is said that the saint or king, desiring the conversion of a brave heathen, named Eindridi, competed with him in various athletic sports, swam with him, wrestled with him, and then shot with him. Olaf then dared Eindridi to strike a writing-tablet from off his son's head with an arrow, and bade two men bind the eyes of the child and hold the napkin so that the boy might not move when he heard the whizz of the arrow. Olaf aimed first, and the arrow grazed the lad's head. Eindridi then prepared to shoot, but the mother of the boy interfered and persuaded the king to abandon this dangerous test of skill. The story adds that had the boy been injured, Eindridi would have revenged himself on the king.†

Somewhat like this, as from the locality might be expected, is the Faroe Isles variant. King Harold challenges Geyti, son of Aslak, and, vexed at being beaten in a swimming match, bids Geyti shoot a hazel-nut from off his brother's head. He consents, and the king witnesses the feat, when Geyti

"Shot the little nut away,
Nor hurt the lad a hair."

Next day Harold sends for the archer, and says:—

"List thee, Geyti, Aslak's son,
And truly tell to me,
Wherefore hadst thou arrows twain
In the wood yestreen with thee?"

To which Geyti answers:—

"Therefore had I arrows twain
Yestreen in the wood with me,
Had I but hurt my brother dear
The other had pierced thee."

With ourselves it is the burden of the ballad of William of Cloudeslee, where the brave archer says:—

"I have a sonne seven years old;
Hee is to me full deere;
I will tye him to a stake—
All shall see him that bee here—
And lay an apple upon his head,
And goe six paces him froe;
And I myself with a broad arroe
Shall cleave the apple in towe."

In the *Malleus Maleficarum*, Puncher, a magician on the Upper Rhine, is required to shoot a coin from off a lad's head; while travelling eastwards, as far as Persia, we find the Tell myth as an incident in the poem "Mantic Ultrair," a work of the twelfth century.

Thus far I have spoken of the variants of the legend found among Aryan peoples, and it is tempting to base upon this diffusion of a common incident a theory of its origin among the Central Asian ancestors of the Swiss and the Norseman, the Persian and the Icelander. But it is found among non-Aryans also. The ethnologist, Castren, whose researches in Finland have secured a valuable mass of fast-perishing materials, obtained this tale in the village Ultuwa. "A fight took place between some freebooters and the inhabitants of the village of Alajärai. The robbers plundered every house, and carried off amongst their captives an old man. As they proceeded with their spoils along the strand of the lake, a lad of twelve years old appeared from among the reeds on the opposite bank, armed with a bow and amply provided with arrows; he threatened to shoot down the captors, unless the old man, his father was restored to him. The robbers mockingly replied that the aged man would be given to him, if he could shoot an apple off his head. The boy accepted the challenge, pierced the apple, and freed his father." Among a people in close contact with an Aryan race as the Finns are in contact with both Swedes and Russians, the main incident of the Tell story may easily have been woven into their native tales. But in reference to other non-Aryan races Sir George Dasent, who has treated of the diffusion of the Tell story very fully in the Introduction to his "Popular Tales from the Norse" (a reprint of which would be a boon to students of folk-lore), says that it is common to the Turks and Mongolians, and a legend of the wild Samoyedes, who never heard of Tell or saw a book in their lives, relates it, chapter and verse, of one of their marksmen. "What shall we say, then, but that the story of this bold mastershot was prominent amongst many tribes and races, and that it only crystallised itself round the great name of Tell by that process of attraction which invariably leads a grateful people to throw such mythic wreaths, such garlands of bold deeds of precious memory, around the brow of its darling champion."* Of course the solar mythologists see in Tell the sun or cloud deity; in his bow the storm-cloud or the iris; and in his arrows the sun-rays or lightning darts.

This is a question which we may leave to the champions concerned to settle. Apart from the evidence of the survival of legend in history, and the lesson of caution in accepting any ancient record as gospel which we should learn therefrom, it is the human element in the venerable tale which interests us most.

Remote in time, far away in place, as is its origin, it moves us yet. The ennobling qualities incarnated in some hero (whether he be real or ideal matters not) meet with admiring response in the primitive listeners to the story, else it would have been speedily forgotten. Thus does it retain for us witness to the underlying oneness of the human heart beneath all surface differences.

Note.—The totemic illustration in the previous paper was copied from Dorman's "Primitive Superstitions," p 238, and Lubbock's "Origin of Civilisation," p. 52.

* Bk. x., p. 166. Cf. Baring Gould's "Curious Myths," p. 117; and Fiske's "Myths and Myth-makers," p. 4.

† Baring Gould, p. 119.

* Introd. xxxv.

THE ELEMENTS.†

Though theoretical and practical chemistry are now intertwined, with manifest advantage to each, they appear to have been far apart in their origin. Practical chemistry arose from the arts of life, the knowledge empirically and laboriously acquired by the miner and metallurgist, the potter and the glass-worker, the cook and the perfumer. Theoretical chemistry derived its origin from cosmogony.

In the childhood of the human race the question was eagerly put, "By what process were all things made?" And some of the answers given started the doctrine of elements. The earliest documentary evidence of the idea is probably contained in the "Shoo King," the most esteemed of the Chinese classics for its antiquity—probably older than Solomon's writings. The elements named are—water, fire, wood, metal, earth. A similar idea of five elements,

† From Dr. Gladstone's Address, Chemical Section of British Association.

differently named, was also common among the Indian races before the fifteenth century B.C. The five are curiously correlated with the five senses, and they are not looked upon as independent material existences, but as derived from one another. This philosophy was accepted alike by Hindoos and Buddhists. It was largely extended over Asia, and found its way into Europe. It was best known to us in the writings of the Greeks. Among these people, however, the elements were reduced to four—fire, air, earth, and water—though Aristotle endeavoured to restore the "blue ether" to its position as the most subtle and divine of them all.

For the modern idea we must again travel back to China. In the sixth century B.C. the great philosopher Lao-tse and his disciples founded the religion of Taou. They held that the souls of the five elements—water, metal, fire, wood, and earth—arose and became the five planets. At the beginning of the seventh century the doctrine of Lao-tse was in great favour at the Chinese court. The disciples of Mahomed carried their arms and his doctrines to the Flowery Land. In the eighth century there were frequent embassies between East and West, wars with Caliphs, and a matrimonial alliance. The teachings of the Taouist alchemists penetrated to Arabia.

Geber, a Sabæan, started what to the west was a new philosophy about the transmutation of metals. The idea became gradually clearer that all material bodies were made up of certain constituents, which could not be decomposed any further, and which, therefore, should be considered as elementary. The introduction of quantitative methods compelled the overthrow of mediæval chemistry, and led to the placing of the conception of simple and compound bodies upon the foundation of scientific fact. Lavoisier, perhaps, deserves the greatest credit in this matter, while the labours of the other great chemists of the eighteenth and the beginning of the nineteenth centuries were in a great measure directed to the analysis of every conceivable material, whether solid, liquid, or gaseous. These have resulted in the table of so-called elements, now nearly seventy in number, to which fresh additions are constantly being made. Of this ever-growing list of elements not one has been resolved into simpler bodies for three quarters of a century; and we who are removed by two or three generations from the great builders of our science are tempted to look upon these bodies as though they were really simple forms of matter, not only unresolved, but unresolvable. The notation we employ favours this view and stamps it upon our minds.

Is it, however, a fact that these reputed elements are really simple bodies? Or indeed, are they widely different in the nature of their constitution from those bodies which we know to be chemical compounds? Thus, to take a particular instance, are fluorine, chlorine, bromine, and iodine essentially distinct in their nature from the compounds halogen, cyanogen, sulphocyanogen, ferricyanogen, &c.? Are the metals lithium, sodium, and potassium essentially distinct from such alkaline bases as ammonium, ethylamine, diethylamine, &c? No philosophical chemist would probably venture to ask this question categorically with either "Yes" or "No."

It was at first hoped that the spectroscope might throw much light upon the nature of elements, and might reveal a common constituent in two or more of them. Thus, for instance, it was conceivable that the spectrum line of bromine or iodine vapour might consist of the rays given by chlorine *plus* some others. All expectations of this have hitherto been disappointed; yet, on the other hand, it must not be supposed that such a result disproves the compound nature of elements, for as investigation proceeds it becomes more and more clear that the spectrum of a compound is not made up of the spectra of its component parts. The general tendency of the arguments is to show that the elementary radicals are essentially different from the compound radicals, though their chemical functions are similar.

There remains still the hypothesis that there is a "primordial element" from which the others are derived by transmutation. With the sages of Asia it was the "blue ether"; with Thales, water; with Dr. Prout, hydrogen. The earlier views have passed away, and the claims of hydrogen are being fought out on the battlefield of atomic weights and their rigorous determination.

There does not appear to be any argument which is fatal to the idea that two or more of our supposed elements may differ from one another rather in form than in substance, or even that the whole 70 are only modifications of a prime element; but chemical analogies seem wanting. The closest analogy would be if we could prepare two allotropic conditions of some body, such as phosphorus or cyanogen, which should carry their allotropism into all their respective compounds, no compound of the one form being capable of change into a compound of the other. Our present knowledge of allotropism and of variations in atomicity affords little, if any, promise of this. The remarkable relations between the atomic weights of the elements, and many peculiarities of their grouping, force upon us the conviction that they are not separate bodies created without reference to one another, but that they have been fashioned or built up from one another according to some general plan. This plan we may hope gradually to understand better; but if we are ever to transform one of these supposed elements into another, or to split up one of them into two or three dissimilar forms of matter, it will probably be by the application of some method of analysis hitherto unknown.

TWO-SPEED TRICYCLES.

By John Browning,

Chairman of the London Tricycle Club.

I TRUST I shall be excused for the delay which has occurred in the appearance of this article, but I have withheld the paper until I could give my experience of each machine to which I have to refer.

The two speed gearings I shall mention in the order in which I have tested them.

First, then, I must name the Crypto-Dynamic. This elegant contrivance I know less of than any of the rest. I tried it once only on good roads. The gearing for hill riding was equal to 23 in., and there was not a steep hill in the neighbourhood. The hill I tried it on I ran up easily, of course. This was more than a year ago, and I have not been able to hear much about the contrivance since; but it will, I believe, be purchasable by the public next month. It is compact, and easily applied to almost any machine; but I fear it will work with considerable friction if it has to rotate at any great velocity. Should this prove to be the case, it will not be well adapted for tricycles with small wheels.

Next I tested Burdess's two-speed Sterling tricycle. This is the simplest contrivance yet introduced. By pedalling forward you drive the machine, which has 46-in wheels, for speed, and it runs as though it were 56 in. By pedalling backward you drive the machine for power, and it runs as though it were 38 in. The motion can be re-

versed easily, three or four times in a minute, while going. There are no levers to move, nor anything to think of. So soon as driving forward becomes harder work than you like you have only to pedal backwards to gain power.

One great advantage of this arrangement is that in driving the slow-speed gearing to ride up-hill, you bring another set of muscles into play, which, of course, act more vigorously; and, meanwhile, those used for riding over the level roads are being rested. The machine is too highly geared for my own riding. Some strong riders would prefer it so. It is excellent in workmanship, and very strongly made. It would be improved if the wheels were smaller and the weight reduced by 10 or 20 lb.; but, even as it is, after trying it for weeks over all conditions of roads, and in all kinds of wind and weather, I can say that I have not been able to get it out of order, and that it runs easily and well.

Lloyd Brothers' two-speed Quadrant Tricycle was the next machine I tested. This is a very ingenious contrivance. The gearing-down of the machine for hill-riding is effected by pressing a lever. This causes the upper chain-wheel to *expand*, and so carry the driving-wheels round slower than the cranks are turning. The machine is a double-driver and front-steerer, central-geared. I tried it up steep hills, over roads rotten with rain, and against a strong wind, and none of these unfavourable conditions stopped me. The machine I tried was the first experimental machine, and so was unnecessarily heavy, but as the makers have produced the lightest "Sociable" yet made, I suppose that future machines of this kind will be proportionably light.

Thanks to the kindness of Mr. Grace, I next tried the "Diana." This machine has two pairs of chain wheels, and two chains. Either of these can be thrown in or out of gear, and the other one allowed to run freely. One chain drives for speed and the other for power. When the high speed is on the wheels are level-geared—that is, 40-in. wheels run as 40 in., 50 in. as 50 in., &c.; in other words, the greatest speed depends on the size of your driving wheels. Pulling back a small lever gears the machine down for hill riding. In an intermediate position of the lever, both chains are out of gear and run free. On long, slight downward inclines this is advantageous.

The machine tried was built specially for Mr. Grace, who kindly consulted me before he had it put in hand.

The wheels are 46 inches, because that was the smallest size the makers could supply.

This, as I have explained, determined the high speed for the level. When geared down the machine ran as 32 inches. I have ridden it on several occasions, once for half-a-day over muddy roads, up-hill, nearly all the way against a wind so high that I had to drive hard even down a long steep hill at the end of my trial. The machine is a great success, but it could be made 20 lb. lighter with great advantage. Making the wheels 40 in., and gearing them up to 48 in. or 50 in. for high speed would facilitate this reduction of weight.

As a proof of the power of the machine, I may say that I have seen Mr. Grace ride it up the steep rough hill which leads from Redhill to Bletchingley—the road at the time being covered with mud which buried the tires and rims, and in this mud there was a quantity of loose stones. This hill is a severe task for a first-rate rider in fine weather when the road surface is in the best condition. Mr. Grace will, I am sure, agree with me that if the "Diana" were made with 40-in. wheels, and were geared so that the speed-gearing ran as fifty inches and the power-gearing as thirty inches, and the weight were reduced about 20 lb., as it might easily be, we should then have a model two-speed machine.

The last two-speed machine I have tried is Grout's "Adroit" tricycle.

This is a lever machine in which the fulcrum of the levers can be changed by turning the holding handle on the left-hand side—that is, on the opposite side to the steering handle. There is so wide a range of adjustment that the machine may be altered while running to equal any gearing from 20 in. to 60 in., and stopped at any point between at pleasure. It is a front steerer and double driver, and the band brake will stop it dead. The machine is light, and the maker will construct it with wheels of any diameter from 40 in. to 50 in. I tried it on rough wet roads and it performed well. With those who do not object to a lever machine I should think the "Adroit" multi-speed tricycle will be a favourite next season.

On a single tricycle the two-speed gearing will be valuable in many ways.

A beginner who commences with a two-speed machine may ride with the power-gearing until his muscles become accustomed to the unusual action, and put on the speed-gearing as he acquires strength in riding.

A man who uses a tricycle for the purpose of carrying a heavy weight will ride with the power-gearing while he is carrying the weight, and with the speed-gearing as soon as he is relieved from it.

Thus, a rider who carries a set of photographic apparatus of the largest size, to take pictures 12 in. by 10 in., which will weigh from 30 lb. to 40 lb., will use his power-gearing only, and will ride with the same ease with a reduction in his speed.

A "Sociable" with a two-speed gearing, when used by a gentleman with an unpractised or weak lady rider, would, as a rule, be ridden geared-down, that is, with the power-gearing; but when ridden by another gentleman as strong or stronger than himself, the same machine would be ridden geared-up, that is, with the speed-gearing, and a much higher speed attained without undue exertion.

Dr. Richardson, in his admirably-suggestive essay, just published in *Longman's Magazine*, has protested against cycling being treated simply as a sport, and has pointed out in weighty words the evils that must ensue from pursuing such a course.

I look forward to the adoption of the "Sociable" tricycle as the most likely means of elevating tricycling as a healthful pastime and an intellectual recreation. The successful application of changeable speed-gearing is a new era in cycling.

Burnham Beeches.—Mr. F. G. Heath is issuing, through Messrs. Rider & Son, at the office of *Forestry*, a shilling edition (illustrated) of his little work "Burnham Beeches." It will appear opportunely in connection with the public dedication of Burnham Beeches, next week, by the Corporation of London.

Evaporation and Electricity.—Dr. L. J. Blake has been investigating the statements of Pouillet and others to the effect that electricity is produced by the simple evaporation of a liquid. He worked with sea-water, sulphate of copper solution, chloride of sodium solution, &c., but in every case the results went to show that electricity is not produced in this way, and that some other means must be found of explaining the production of atmospheric electricity. Dr. Blake also negatives the hypothesis of Franklin and others to the effect that electricity is conveyed by still evaporation from an electrified liquid. The experiments were conducted with a quadrant electrometer of M. Voss, Berlin.—*Engineering*.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

V.—THE DAISY.

(*Continued from page* 188.)

"Hail, holy light, offspring of Heaven first-born."—*Milton.*

Bend and distort any plant as we may, the strongest proof that it is wrested from its original and inherent nature will be in the ceaseless efforts which it evinces to raise its struggling branches to the skies. In like manner sea anemones follow this law of vegetable life, though feeble, indeed, must be the ray in those sea-depths where some of the largest and brightest species flourish and bloom.

Darken the top of the aquarium, and Daisy bends her stem that the disk may face the lighter side of her home, and though some actiniæ are impatient of a strong light, it would seem that utter and continued darkness are incompatible with full health in any species, and the free expansion of their flower.

The daisy—as before pointed out—differs from all other anemones in having comparatively a very slender column, whose average diameter is not more than one-fourth that of the disk; she is prolific, and in many cases both viviparous and oviparous. The fully-formed young are discharged from the *gonidal grooves,* whence the ova also make their appearance. The shape and marking of the newly-born daisy are readily recognised, the chief distinction between the young and their parent being, apart from size, the small number of tentacles—not more than a baker's dozen—and these are larger in proportion in the young than in the adult.

It has been frequently noticed in anemones generally that a large animal has large offspring, the reason being, it is very naturally concluded, that a large body allows more space for the fuller development of the young before they are brought into the world than it is possible in the case of a small parent that is equally productive. The mature ova, however, are observed to be of the same size in the same species.

Bellis is sometimes obtained from deep water, but its favourite resorts are pools, crannies, rock fissures, and other similar hiding-places between tidal limits. In many such cases daisy is difficult to get at, for when the disk can be seen and reached, the base is found to be fixed in some crevice which the animal has chosen for safety. A hammer, steel chisel, and great patience are then necessary, as without these three requisites there is a strong probability that in tearing away the animal the central portion of the base will be left behind. The creature so mutilated will afterwards occasionally expand its bloom and look healthy for a time, but seldom survives its proper period. Cases, however, are met with in many species in which immoderate wounds and lacerations heal, and lost parts are restored. The safest way, and the most satisfactory to both parties—daisy and her captor—is to cut off a piece of the conglomerate to which she is usually attached.

Still colonies are not unfrequently met with in situations more favourable to the collector, as in superficial fissures, and shallow hollows of coarse sand, or pudding-stone, where, at ebb tide, only a few inches of water cover them. In these situations they are frequently so crowded that their disks pressing upon each other lose their circular shape. The flower is puckered and frilled, filling all the interstices, and presenting a continuous surface of distorted disks. The amount of bright colour thus displayed is inconsiderable, but the effect upon close inspection of the convoluted and fringe-like pattern is pleasing for its novelty. Mr. Gosse mentions a variety of this species ("Actinologia," p. 33), at Weymouth, which he names *Sordida.* These anemones are met with on fetid mud, and are dingy in appearance. Their bases simply rest on the slime, but when removed to a vessel of clear sea-water, they very soon become attached to the bottom or side. They differ widely from the Cornish mud-dwelling variety described on page 188.

The Daisy is a hungry creature, and will eat varaciously bits of meat, fish, oysters, worms, or almost any animal substance. For the most part *bellis* is stationary, and when in sound health is nearly always open. She is essentially a southern beauty, more of a French than an English *belle,* somewhat Irish, and very little Scotch.

Daisy has been found on the south-west shores of Scotland, in Rathlin Island, Dublin Bay, and the south and west coasts of England and Ireland. She is constantly being captured at Boulogne and in the Channel Islands; she is also found by myriads near Oporto. The older writers, Lamark and Blainville, give the shores of the Mediterranean as her chief *habitat,* but pre-eminently the Bay of Naples.

In Dana's great American work there are three brilliant anemones named and described, which have some of the leading traits and habits of Bellis—*Actinia decorata* from a Lagoon of Honden Island, *A. Fuegiensis,* and *A. Impatiens* from crevices of rocks and tide-pools in Orange Harbour, Terra del Fuego.

The examples of daisy in the Fisheries are not numerous, and are scattered in various small vases and tanks, but amongst them are a few very good specimens. By the way, all the tanks now (Sept. 21), are in excellent condition, the water in them is bright, and the greater part of, if not all, their denizens appear in vigorous health and are seen to great advantage. Only a week or two ago this was not the case, and just criticisms were beginning to make their appearance in the daily press. The improvement, however, has been prompt and so far very complete and effectual.

This department continues to be one of the most attractive in the Exhibition—more particularly when illuminated in the evening, and all the tanks, in consequence, are then excessively interviewed, without regard for the comfort or welfare of their occupants. Frequent renewals of the less hardy are therefore indispensable under the present pressure of visitors.

Where practicable, the anemone and other tanks should be looked at during the early part of the day, as by the electric light anything like a careful and quiet examination of them is impossible.

Electric Lighting in Mills.—A mill situate on the banks of the Doria, near Turin, is lighted by means of sixty-four Swan lamps. The current is supplied by a Gramme dynamo, driven by the water-wheels of the mill. The speed of the dynamo does not exceed eight hundred revolutions per minute. The installation is reported to give great satisfaction. The Swan lamps have replaced colza oil.—*Electrician.*

Edison System in the House.—Mr. Shaw Lefevre has purchased the Edison plant which has been in use at the House of Commons during the past Session. He intends, owing to the success attending the existing installation, to adopt the light as a permanency, and to considerably extend its use. The existing plant consists of 250-light dynamos, and 276 lamps, with all necessary fittings. The new plant will comprise an Armington and Sim's high-speed engine, and two L (250-light) dynamos. The total number of fresh lamps to be employed will be 214.

TRUTH AND POKER.

By Richard A. Proctor.

AN angry man is apt to appear unfavourably in a fencing bout. He aims wildly at a seemingly exposed but really well-guarded spot, leaving himself open to a *riposte* which, but for his wild attack, might easily have been foiled. I fear Mr. Labouchere must be angry with me, he has twice attacked me so thoughtlessly. (Yet have I given him no just cause for anger.) *Truth* need not have a bad memory, though untruth we are told should have a good one. One week it rushes out with upraised cudgel, to fell me to earth by calling my article on Poker in *Longman's Magazine* a silly paper which proves too lengthily that two and two make four, yet (strangely) quoting as "curious" my enumeration of poker hands: next week another way of hitting at Proctor's Poker is tried (any stroke seems right to the blindly angry).

"A correspondent writes" (says Mr. Labouchere) "to point out the inaccuracy of Mr. Proctor's 'Poker Figures,' which I cited last week. 'There can,' he says, 'be only 78 possible pairs in an ordinary pack of cards, and not 1,098,240, if any two cards of the same denomination constitute "a pair." So, too, in regard to "triplets;" he thinks there can be 54,912; I contend there can only be 52. Again: he makes "fours" produce 624, whilst I can only make them produce 13. It appears to me that your authority (whom you did not appear to deem much of an authority) considers any two cards to be "a pair," instead of two cards of the same denomination.' I merely quoted the calculations from an article on Poker, by Mr. Proctor, in *Longman's Magazine*, *quantum valeant*."

Yes; but, my good sir, you should have a better memory: you accompanied your quotation with the remark that my article proved only that "two and two make four, with other such matters of universal cognition." (I quote from memory, but I can trust *my* memory.) It would seem that now you are in doubt whether two and two make four, and not (perhaps) five, or (it may be) three. After showing your familiarity with whist by confounding "finessing" with "underplay," you further illustrate your "universal cognition" by inserting preposterous comments as possibly valid criticism,—but possibly not, you cannot for the life of you say which. Permit me to remark (I will not say "explain," lest you should remind me then of your "universal cognition") that though there are only 78 possible "pairs" in an ordinary pack of cards, there are 1,098,240 "pair hands" at poker; though there are only fifty-two possible "threes," yet there are 54,912 "triplet hands"; though there are but thirteen "fours," yet are there (as I have said and shown) 624 "four hands;" and lastly if (becoming temporarily idiotic) I had supposed *any* two cards to be a "pair," I should still not have arrived at the number 1,098,240, the total number of two-card combinations in a pack being only 1,326.

[These and similar relations in card games I may shortly discuss in these columns—at the risk, even, of being told (by, but not with, *Truth*) that I am dealing with matters of universal cognition.]

EVOLUTION OF CONDUCT.

WHAT says the doctrine of evolution with regard to the ethical side of this twofold assertion that lies at the bottom of all religion? Though we cannot fathom the nature of the inscrutable Power that animates the world, we know, nevertheless, a great many things that it does. Does this eternal Power, then, work for righteousness? Is there a divine sanction for holiness and a divine condemnation for sin? Are the principles of right living really connected with the intimate constitution of the universe? If the answer of science to these questions be affirmative, then the agreement with religion is complete, both on the speculative and on the practical sides; and that phantom which has been the abiding terror of timid and superficial minds—that phantom of the hostility between religion and science—is exorcised now and for ever. Now, science began to return a decisively affirmative answer to such questions as these, when it began, with Mr. Spencer, to explain moral beliefs and moral sentiments as products of evolution. For clearly, when you say of a moral belief or a moral sentiment that it is a product of evolution you imply that it is something which the universe through untold ages has been labouring to bring forth, and you ascribe to it a value proportionate to the enormous effort that it has cost to produce it. Still more, when with Mr. Spencer we study the principles of right living as part and parcel of the whole doctrine of the development of life upon the earth; when we see that, in an ultimate analysis, that is right which tends to enhance fulness of life, and that is wrong which tends to detract from fulness of life,—we then see that the distinction between right and wrong is rooted in the deepest foundations of the universe; we see that the very same forces, subtle and exquisite and profound, which brought upon the scene the primal germs of life and caused them to unfold, which through countless ages of struggle and death have cherished the life that could live more perfectly and destroyed the life that could only live less perfectly, until humanity, with all its hopes and fears and aspirations, has come into being as the crown of all this stupendous work—we see that these very same subtle and exquisite forces have wrought into the very fibres of the universe those principles of right living which it is man's highest function to put into practice. The theoretical sanction thus given to right living is incomparably the most powerful that has ever been assigned in any philosophy of ethics. Human responsibility is made more strict and solemn than ever, when the eternal Power that lives in every event of the universe is thus seen to be in the deepest possible sense the author of the moral law that should guide our lives, and in obedience to which lies our only guarantee of the happiness which is incorruptible—which neither inevitable misfortune nor unmerited obloquy can ever take away.—John Fiske.

RELIEF OF SEA-SICKNESS.

IN spite of the fact that much has been written on the subject, people still continue to suffer from sea-sickness, which proves the unreliability of our therapeutic resources. Therefore the following experience of Dr. T. M. Kendall, who has recently had 200 cases under his charge, may prove interesting:—

Many people, as soon as sea sickness commences, have recourse to oranges, lemons, &c. Now oranges are very much to be avoided, on account of their bilious tendency, and even the juice of a lemon should only be allowed in cases of extreme nausea.

Champagne, too, is a very common remedy, and, without doubt, in many cases does good; but this appears to be chiefly due to its exhilarating effects, as if it be discontinued, the result is bad, and a great amount of prostration follows.

Creosote is a very old but still very good remedy, and, in cases accompanied by great prostration, is very useful;

but if given in the early stages of sea-sickness, it is often followed by very bad results, and even increases the nausea.

Bicarbonate of soda is useful in slight cases, as it relieves nausea, and checks the frequent eructations which often follow attacks of sea-sickness; but in severe cases it is absolutely useless, and, in fact, it very often prolongs the retching.

A very good remedy in the earlier stages of sea-sickness is a teaspoonful of *Worcester Sauce*. How this acts I cannot say; but it without doubt relieves the symptoms and renders the patient easier. Its action is probably of a stimulant nature.

Hydrocyanic acid is of very little service, and most acid mixtures are to be avoided, except that, perhaps, for drinking purposes, when it is best to acidulate the water with a small quantity of hydrochloric acid.

Of all the drugs used, I found the most effectual was *bromide of sodium*. When bromide of sodium is given in doses of ten grains three times a day, the attacks entirely subside, the appetite improves, and the patient is able to walk about with comfort.

In all cases of sea-sickness, it is very desirable that the patient should take sufficient food, so that at all times the stomach may be comfortably full, for by this means overstraining during fits of retching is prevented, and the amount of nausea diminished. The practice of taking small pieces of dry biscuit is not of much use; as, although the biscuit is retained by the stomach, yet the amount taken is never sufficient to comfortably fill the stomach. Soups, milk puddings, and sweets are to be avoided, as they increase the desire to be sick and are followed by sickening eructations. Fat bacon is easily borne, and does much good, if only the patient can conquer his aversion to it. When taken in moderate quantity, it acts like a charm, and is followed by very good results.

But of all food, *curry* is the most useful in sea sickness, and is retained by the stomach when all other food has been rejected. Next to curry, I would place small sandwiches of cold beef, as they look nice on the plate, and are usually retained by the stomach.

In conclusion, I would advise that brandy should be used very sparingly, as in many cases it induces sea sickness; and its chief use is confined to those cases where the prostration is very great, and even then champagne is more effectual.—*Scientific American.*

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

GOETHE anticipated the mode of studying nature now generally admitted to be right, when he said to Eckermann, "The utility teachers say that oxen have horns to defend themselves, but I ask, why is the sheep without any? If, on the other hand, I say the ox defends himself with his horns because he has them, it is quite a different matter." Some shallow thinkers have regarded this mode of reasoning as opposed to a recognition of design in nature, but it is not so. Sciences of observation and experiment have to do only with how and what. The *why* remains for philosophical consideration, and as the old design argument fades away on account of its narrowness and insufficency a much grander one arises, showing that the adaptation of organisms to their surroundings arises out of general laws, and cannot be rightly viewed as so many disconnected exhibitions of creative skill. Let us examine two insects belonging to the great Order Hymenoptera, and notice how importantly their mouth organs help to determine their way of living. If the head of a wasp is looked at with a hand magnifier, immediately below its upper lip two remarkably powerful mandibles are seen. They work—as insects' jaws generally do—horizontally, and are furnished with strong, pointed teeth. Look in the same way at a honey bee. Its mandibles are much smaller, its face looks more innocent; quite mild as compared with the tiger-like countenance of the wasp. Its jaws inform us at once by their aspect that the creature will not be engaged, as the wasp will, in hard biting work. Extending a little beyond the mandibles, the pocket lens will show, in the wasp, a short, squarish, three-cleft organ of gauzy texture, the centre portion being the biggest, with a yellow spot at each tip, and similar spots, one each at the tips of the side divisions. This is a lapping tongue. The bee's tongue is also a lapping one, but constitutes a much larger and more powerful-feeding machine. It lies between two labial palpi and two maxillæ, which all join to form a tubular sort of sheath for it.

A good way to know something of this remarkable apparatus is to catch a bee in a bottle, and see it feed. For this purpose a wide-mouthed bottle, of thin glass and about one inch in diameter, will do; or, still better, a wide-mouthed test-tube, which can be bought for one penny, and which should be fitted with a cork not tight enough to exclude fresh air. The bee is easily caged while busied with a flower. Let it have a little time to recover from its astonishment and alarm, and then, while it is in the bottom of the tube, withdraw the cork, and put a little syrup of sugar and water upon it before replacing it. Previous to commencing dinner, the bee's tongue and adjacent mouth-organs look like a brown flattened tube of gutta-percha, curved—if one may so speak—under its chin, and towards its breast. As soon as it finds the syrup, the jaws open, the tongue is thrust forward between them, and an unexpected piece is shot out beyond the maxillæ. The pocket lens will indicate that this portion is very hairy, especially towards its tip. It may, in fact, be likened to a long-haired flexible broom, and the insect uses it accordingly. The long hairs all point downwards, so that, when the creature bends the end of the tongue backwards, lays it along the cork, and then draws it forwards, it acts exactly as we should do if we were using a flexible brush to wipe up a slop. Every now and then the creature draws the tongue between its hairy fore-legs, as if to clean it, but the action may also bring the fluid down to an orifice through which, I think, it is sucked up. Another curious motion may also be seen, that of thrusting the tip of the tongue backwards towards its body. Is this only another cleaning process? or does the bee propose to carry off some of the syrup sticking to its hairs? Let the reader catch some bees, feed them well, and pay attention to their ways.

In a former number will be found figures of the mouth organs of the biting breeze flies. Their maxillæ are carving-knives, very unpleasant when used upon ourselves. The bees' maxillæ serve quite another purpose; they are not cutting implements at all, but combine with the next inner organs, the hairy labial palpi, to cover the tongue, and stroke down the fluid it laps up, when the insect rapidly withdraws the extended part up into the tube-like sheath which they form. This is the interpretation of their use which watching the feeding process suggests.

It is evident that the wasp's very different tongue could not do such effective lapping, and its shortness would prevent its gathering the nectar of many tubular flowers, as

the bee can do. But the wasp can bring his jaws to aid; and a little while ago, when Redhot Pokers (*Tritomauvaria*) were in bloom, numbers of wasps might be seen biting holes round the bottom of the tubular flowers, and thus enabling their short tongues to get at the coveted nectar.

It may be incidentally mentioned that the Redhot Poker was introduced from Africa no great while ago, and English wasps must have contemplated it as a strange plant, which neither they nor their grandfathers had ever fed upon. The first wasp who tapped its corolla must have been an adventurous experimenter—in his way a reasoner from analogy, and a benefactor to his race.

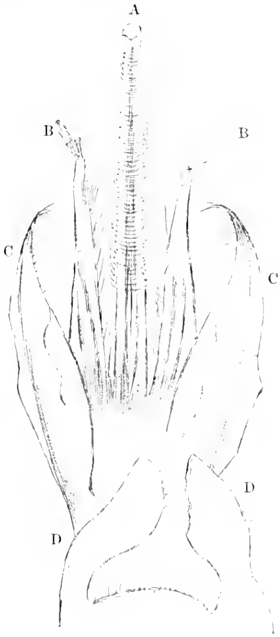


Fig. 1.—Mouth-organs of Honey Bee. A. Tongue extended. BB. Labial palpi. CC. Maxillæ. DD. Mandibles, depressed to show other organs more plainly. When the bee sucks the tongue, &c., are raised and protruded between them. (Drawn from the objects uncompressed by Mrs. Slack.) × 20.

We shall proceed in another paper to a minute examination of the bee's mouth organs, but will now further consider what more the examination with a pocket lens suggests.

Having regard to the size of the two insects, and to the small quantity of food required for a creature that completes its growth at the time of its emergence from its pupa state, the bee's mouth organs suggest that it might gather much more food than its own needs require, while the wasp's mouth organs suggest that a more varied food and a smaller quantity may suit its habits. This is the case. The bee has not only to feed a host of young during the warm months, but to lay up a store of food for a large population to live upon at waking times during the winter. The wasp has also to feed its young, but when the cold weather comes the bulk of the colony dies, leaving only some females to lay eggs and found a fresh city of paper houses when spring returns. The bee, making its comb and cells of wax, needs to eat the right food for this substance to be secreted. The wasp, to create its paper, has to bite wood and other substances which its big strong jaws make easy work, but which the bee's jaws are not fit for. A bee could make no impression upon a firm apple, but a wasp soon gnaws a great hole in one, chiefly to suck its juices, as its small waist would forbid the passage of solid particles, unless of very minute dimensions.

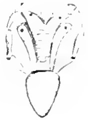


Fig. 2.—Wasp's tongue and labial palpi. (Copied from Westwood.) × 10.

The mandibles, or jaws, of the bee come into special use in forming the comb. The wax is secreted in thin plates between the segments of the abdomen. This substance is kneaded by the mandibles, and added layer by layer to form the comb. In its early stage this consists of shapeless blocks, which the mandibles mould into shape. The mandibles serve a great number of other purposes. They are the insects hands as well as cutting tools. The subject will be continued in the next paper.

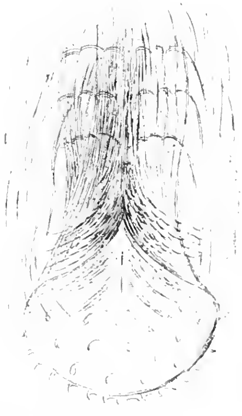


Fig. 3.—Tip of Bee's tongue, underside uppermost. (Drawn from preparation in Canada balsam by Mrs. Slack.) × 600.

Editorial Gossip.

A great deal has been said about newspaper science, which is often spoken of as if it were uniformly valueless. That this view cannot be altogether correct is shown by the circumstance that many of our most distinguished men of science have written newspaper articles on their own special subjects, and that such articles have not unfrequently been embodied subsequently in scientific works of high standing. I am myself somewhat unwilling to see newspaper science systematically abused and ridiculed. For I have written many hundreds of newspaper articles—not all, by the way, on subjects which belong to my own special lines of research. I have always strictly limited

what I have said to what I knew and understood, not thereby always escaping error (for this none can do) but escaping the blunders which necessarily arise when the blind undertake to lead the blind. This rule, carefully and honestly followed, should be all that is necessary to keep newspaper science above reproach.

But unfortunately many who write for our daily and weekly papers are not troubled with much fear of bringing reproach upon newspaper science or on the particular newspapers to which they are good enough to contribute. The editor of a newspaper cannot be familiar with every department of science, if even with any. He cannot always be able even to distinguish those who are competent to write on any subject from those who are not. If a man known to have done good work in one department of a particular science offers to write on any matter connected with the subject, and possesses a tolerably effective literary style, an editor can hardly be blamed if he accepts and inserts the proffered contribution, even though it should turn out to be in reality utterly valueless and full of egregious blunders. The dishonesty of the writer is the real trouble, not the editor's want of scientific knowledge—a kind of knowledge not to be expected in a man who has to give his attention to other and very different matters.

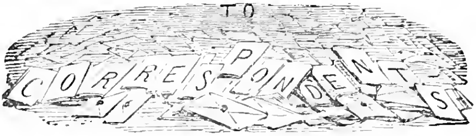
These remarks have been suggested by the reading of a leading article in the *Times* of Saturday, September 22, on the subject of Dr. Ball's excellent discourse on the Sun's Distance now appearing in these pages. Who may be the author of the article, I have no means of knowing. That it has appeared in such a paper as the *Times* is sufficient evidence that the writer has done some good work, or has the general credit of having done such work, in astronomy; for otherwise the article would never have been accepted. But that the writer is hopelessly ignorant of the elementary mathematics of astronomy is equally obvious. It becomes very difficult, therefore, to explain how, without dishonesty, this article came to be written for the *Times*. If there is a less unpleasant explanation, let us hope that before long it will be given; for, while the occurrence of occasional errors or even blunders in newspaper science may cause no great harm in the long run, the display of deliberate dishonesty such as has in this case, I fear, been shown, would be a serious misfortune.

It is not to correct the errors in the article in question that I point them out, but because they are part of the evidence of what appears to me deplorable want of principle in some writer unknown. Here is an article on astronomy in a tone implying right to speak "as having authority." The writer talks condescendingly about "the mind of the average man," about "non-scientific persons," and so forth, and about the enlarged conceptions which such folk should form of "the laborious and patient accuracy of scientific work." But while, in the whole article, there is no trace of original thought or of any real grasp of what Dr. Ball himself had clearly explained in his lecture, there are blunders such as none but a charlatan writing of what he knew nothing about could possibly have made. We are told that Neptune was "looked for in the position from which its disturbance was exercised," which is preposterous; that the "larger of the asteroids, under favourable conditions, come within" such and such distances of the earth, as if size had anything to do with the matter; and that Dr. Ball saw Venus (at Dunsink) in the middle of her transit last December, the middle of the transit occurring long after the sun had set at Dr. Ball's station. But these are only blunders, showing indeed the ignorance and inaccuracy of the writer, and otherwise insignificant. What, however, is to be said or thought of the deliberate statement that, "in consequence of the motion of the earth round an elliptical orbit, the distance which separates us from the sun is variable, being greatest when our planet is on the major axis, smallest when it is on the minor axis of the ellipse"? If the statement had been less precise in its nature, we might have supposed that the error had arisen from mere carelessness; but in the sentence as it stands the writer deliberately expresses and even emphasises his ignorance. Nobody who knew, as every one familiar with the elements of astronomy must know, that the earth is nearest to the sun when passing one extremity of the major axis of her orbit, farthest from him when passing the other, and at his mean distance when on the minor axis, could possibly have made such a statement as we have quoted. One would only too willingly ascribe it to mere carelessness on the part of one who really knew better; for by so doing the evidence of dishonesty might be overlooked. But unfortunately no such interpretation seems possible.

Completion of Second Million Issues at Mitchell Library, Glasgow.—This library has now completed the second million in the number of volumes issued to readers, and advantage may be taken of this circumstance to draw attention to the very remarkable degree in which Mr. Mitchell's benefaction has been appreciated and made use of by all classes of the citizens—artisans, clerks, students, and professional men. The first book, "Liber Officialis Sancti Andree" (Abbotsford Club), was issued at ten o'clock in the morning of Nov. 5, 1877; the first million issues were completed Jan. 14, 1881, being 982 working days from the opening; the second million issues were completed at 6.45 p.m. on Saturday last, Sept. 1, 1883, and occupied 808 working days. It is believed that there is no previous instance on record of the issue of two million volumes within so short a period of the opening of a public library. As will be seen from the statistics below, the reading of fiction forms but a small proportion. It should be stated, too, that in addition to this large number of volumes asked for at the counter there has been a very great use made of the current periodicals—literary, artistic, scientific, technical, professional, and other—which, to the number of more than 200, lie openly upon the tables. The following is a statement of the number of volumes issued in each of the classes in which the library is arranged, with relative proportion of the whole issue:—

		Per Cent.
Theology and philosophy	184,681	(9·23)
History, biography, &c............	435,326	(21·77)
Law, politics, and commerce ...	54,694	(2·73)
Arts and sciences	402,485	(20·12)
Poetry and the drama	147,115	(7·36)
Language.............................	54,971	(2·75)
Prose fiction	145,605	(7·73)
Miscellaneous literature	566,123	(28·31)
Total.....................	2,000,000	(100·00)

Of the whole issue, no more than 10,481 volumes have been issued to ladies, or only 5 per cent. This small attendance of ladies is regretted, but is probably due to the absence of separate accommodation of a suitable character.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

SIR WILLIAM HERSCHEL.

[947]—I shall feel obliged if your contributor "A Fellow of the Royal Astronomical Society"—the one, I mean, who wrote "The Sun in a Three-inch Telescope"—will communicate his authority for the statement that "Sir William Hershel lost an eye" in an attempt to look at the sun without suitable protection. It may be true; but to the best of my recollection I never heard of it before.

Collingwood, Sept. 28, 1883. J. Herschel.

ASTRONOMY OF THE *TIMES*.

[948]—The *Times* of September 22nd, in its leader on Professor Ball's address to the British Association, informs us, in reference to the Earth's Orbit, that "the distance that separates us from the sun is variable, being greatest when our planet is on the major axis, smallest when it is on the minor axis of the ellipse," so that, putting a for the semi-major axis of the earth's orbit, and e for the eccentricity (when, of course. $e<1$) we must infer from the *Times* that

$$a\,(1-e) > a\sqrt{1-e^2},$$

and therefore, that

$$\sqrt{1-e} > \sqrt{1+e}.$$

which is, &c. J. R. C.

CURIOUS PHENOMENON.

[949]—In your number of September 14 last, page 173, is an account of a curious phenomenon, which is illustrated by an engraving.

This evening, Sept. 21, at 8.30 p.m., I observed just such a phenomenon also in the E.N.E., about 20° above the horizon.

The sky was cloudy at the time, and in the very words of the article mentioned, "For a moment I imagined that I was viewing the apparition of a new and glorious comet," the light was too white to have an artificial terrestrial origin; it remained well in view for five minutes, but before I could bring a telescope to bear upon it, it slowly faded. Mrs. Harbin.

Preston House, Yeovil.

THE "SUN AND PLANET" BICYCLE.

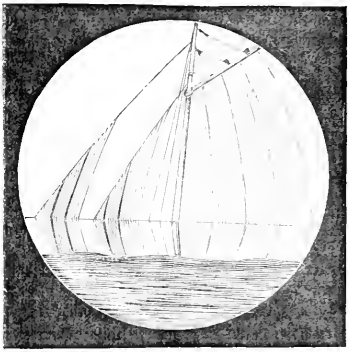
[950]—There are two misprints in my letter (942). In line 9, the word "seat" should be "feet"; and about "Sigma," I said that he seemed to have *no* idea that Mr. Browning spoke of *geared-up* wheels.

As to appearance, I should think a man looked better on a small, neat machine than inside such a squirrel-cage as a 60-inch "Otto."

S. J.

HULL-DOWN SHIP.

[951]—Your interesting articles called "Pretty Proofs of the Earth's Rotundity" have caused me to take a new interest in the visible sea-horizon, and I have been observing it while on the south coast recently with a 3½-inch telescope, of the kind recommended in Knowledge. But a phenomenon I do not understand at all has presented itself: to a ship, hull-down there have seemed to be two horizons, a nearer one clear and distinct, on which the rise and fall of the waves could be seen, and a farther



one which really concealed the ship and gave it the appearance of floating in the air; and still more oddly a kind of reflection of the ship's sails connected the more distant with the nearer horizon, something as in this sketch, which I hope you can make out. Is this usual? Would you kindly explain it for the benefit of myself and a few friends who saw but could not understand it, and you will greatly oblige H.A.L.S.

[Doubtless there was a layer of still air above the distant water surface, of density greater than that of layer of air next above it; and the ship was reflected in that as in a horizontal mirror. R. P.]

TOTEMISM.

[952]—Mr. Edward Clodd, in the fifteenth chapter of his interesting series of articles on "The Birth and Growth of Myth," touches on the customs and prohibitions which *totemism* has imposed upon savage and barbaric peoples; he quotes as instances the American-Indians and Australian tribes. He also speaks of a form of salutation common to a certain province in China, but he has omitted to notice a singular custom of the same type which prevails in the native States of Cochin and Travancore in the Southern part of the Indian peninsula.

These States cannot be styled savage or barbaric. One-third of the whole native population is Christian; of the native castes, the so-called Namburi Brahmins rank first; after them come the Nairs. It is of these we would speak. The rulers of these States are themselves of Nair descent. When they succeed to the throne they are *made* Brahmins. They are "new-born" by passing through a golden cow, or vessel of that metal, which then becomes the property of the Brahmin priests.

The females of the Royal families in these States invariably marry Brahmins, but all Nair women have the privilege of choosing their own husbands; by law they may change them as often as they will, but this, it is said, is going out of fashion.

Obviously, this custom led to great confusion in the matter of inheritance; therefore amongst the Nair caste a man's heirs are not his own children—his property descends to the children of his sisters or of his female cousins, however remote.

With regard to polyandry, we think it will generally be found to exist in mountainous districts, and where the soil is very poor and can only support a very small population. Such, at least, are the conditions in Ladakh, or Western Thibet, where this custom prevails. Certain Europeans, who closely watched them for some years with that object, could never discover that its inhabitants practised infanticide. Cosmopolitan.

LETTERS RECEIVED AND SHORT ANSWERS.

E. D. Girdlestone. *Imprimis*, let me remark that I only object to the waste of time over the study of formal logic, especially by those who are capable of reasoning correctly. I would not in the slightest degree object to your studying logic. And now to your illogical defence of Jack Ketch. You argue correctly enough about a suppositious Jack Ketch, who never existed save in your imagination. If the legislature had to select an executioner from among

a number of citizens, all unwilling to take the office, but ready to do so as a duty when actually called to the work, no one would think of calling the executioner a murderous ruffian. I apply that term to each one of those who have been in the past, are now, or will hereafter be (so long as our present system continues) eager candidates for an office which none but a murderous ruffian would accept, if he could avoid it without failing in duty to his countrymen. If you can believe that the numerous applicants who have come forward for the office within the past few weeks have done so with a feeling of repugnance against taking life, but a feeling also that it was their clear duty to offer themselves for the work, a painful duty which they could not conscientiously avoid,—why then, you can believe anything, and reasoning would be thrown away on you. Every one knows that the actual case is very different, that every one of the applicants (every man Jack or Jack Ketch of them) has deliberately sought to adopt man-killing as the business or part of the business of his life. It is well, in the horror which the presence of so many brutally-minded wretches amongst us must excite in every rightly-constituted mind, to find that some of the "hangman knaves" are ashamed to let their names be known, *until sure of the office.* To compare soldiers with hangmen is sheer nonsense. A soldier is primarily a man who takes as his office a part in the work of defending his country at the risk of his own life and limbs. His country may engage in wicked wars, and the necessities of the service, the rules of its discipline, and so forth, may make him one of the number of those employed in wars of that particular kind. During the course of such wars his hand may take away the lives of other men. But no soldier ever gets enlisted with the thought that it would be a pleasant thing to him to take away life; whereas there never yet was an applicant for the office of common hangman who was without this hideous incentive. It would not be a bad thing for the future of this country if every man who had publicly announced his readiness to take away life, his eager hankering for the hangman's office, were removed, along with his children and his nearest kinsfolk, to a place where they could be kept apart from their fellow men till the lot had in due course of nature died out. I say it would not be a bad thing for the country, not that it would be just, especially to the kinsfolk; for in many cases these murderous folk are sports of nature, their kinsfolk being often gently-minded, worthy people. But it is terrible to think of these slaughter-loving men marrying and multiplying their kind in our midst.—J. Terry Patch. I think no such statement of the plan and purpose of Knowledge at all necessary, after what has been so clearly said (and so often) already. It seems to me unreasonable to insinuate that Mr. Clodd intended "a sneer at the faith of Christians" in speaking of the injunction to the Hebrews against eating pork as not actually a revelation of God's will. (You misunderstand Mr. Clodd's use of "pseudo" in combination with the word revelation; he does not mean either a false revelation or the statement of something false as if it were a revelation, but simply that a certain statement has mistakenly been regarded as a revelation.) You might as reasonably accuse your neighbour at breakfast or dinner of intending a covert insinuation against the faith of Christendom when he takes ham with his eggs or bacon with his chicken! Read what the reverend head-master of Clifton has said about inspiration, and you will find abundant evidence that the ablest and most learned theologians reject the idea of inspiration of the kind you imagine, while the fiercest enemies of the faith you fancy you are defending find in the doctrine of *such* inspiration the readiest and most effective weapon of attack. No wonder with such views as yours you think Knowledge not always neutral. How *could* it be with such neutrality-laws as you would enjoin?—W. J. Brindle. Your man-servant mistook a dark part of the moon for an eclipse shadow. The mistake has been made before when the moon has been five or six days past the full. "Whitaker's Almanac" naturally did not predict the occurrence, nor as you say did "F.R.A.S." in "The Face of the Sky." The sympathetic inks you describe hardly fulfil Mr. Wood's requirements.—Jas. Walker. We do not undertake to work sums. But here is a general way of working out such problems. Let h be the height of a right cone, V its volume, and v the volume you want to cut off by a plane parallel to the base. (In your case v is V/3 for one section and 2V/3 for the other.) Let x be the distance of the required section from the vertex. Then we have the proportion

$$V : v :: h^3 : x^3$$

whence you find x at once, because V, v, and h are known.—D. Mayer. Your mathematical papers received, and kept for future use. But other matter received earlier awaits insertion. Much obliged to you for it.—E. G. S. So-called spiritualism is associated with so much rascality that I would not care for papers explaining how the tricks are usually done.—H. Jones. (1.) The telescopes are different; but not having seen one of them can express no opinion as to their relative merits. (2.) "The Stars in their Seasons" quite different from "New Star Atlas": the former is constructed especially for England and places in about same north latitude; the latter is an atlas of the whole star sphere, and as well suited for any latitude, north or south, as for the latitude of London.—A New Reader. Thanks for magic square, which I will insert with description. I hope it is not one of those which have already appeared in Knowledge; but really have not time to hunt them all up. This must be the last for the present of magic squaredom.—W. H. Milnes. I am no authority in matters classical; but it seems to me there *is* a rather abrupt change of mood in the motto *Aut nunquam tentes aut perfice*, and that two subjunctives or two imperatives would be better. But I may be quite wrong.—C. H. Marriott. Do not know who is the publisher of Mr. Chimmo's book. A bookseller would be able to tell you.—A. G. Grenfell. Scarcely. Should say advertising might be of use.—Naggdribb. Thanks for cutting with Capt. Delanney's nonsense. Hope the spelling of name correct, and that he is not really a namesake of the eminent Delaunay.—A. Hubble. Thanks, but seldom have room for translations, and when I do I translate them myself.—Perplexed. Probably the difference arises from the way of blowing. The correctness of the law for closed pipes, even with the comparatively rough test you indicate shows that the law is sound enough.—W. N. Huddy. Probably long continued pressure on the eye during sleep had produced a temporary change of shape in the lenses.—A Wellwisher. Very glad the notice led you to a useful little book.—Welshman. Unfortunately do not know how bones may be melted so as to be moulded into any required shape. Should have thought it impossible.—Zer-ubba-bel. Know absolutely nothing about masonic keys, and am therefore unable to explain how the Tau figure is used in measuring the celestial globe.—J. D. Am away from Nautical Almanack, but for your purpose you should use that excellent work. It gives the R. A. of Polaris, and for each day in October (or any other month) you can readily find the time when Polaris is on the meridian either above or below the pole. If we were to solve every such problem which occurs to our numerous readers, we should find time running rather short.—A Subscriber. The question is momentous, and quite in my line as a student of mathematics, astronomy, and so forth:—"*Can* horses breathe with their nosebags on them, filled with chaff and corn?" Your humble opinion is, "that they are then in a state of suffocation"; and "for the last seven years" you have "brought out a ventilating nosebag." (Brought it out where and how?) My humble opinion is that horses, whether full of chaff and corn or not, can breathe and do breathe, with their nosebags on them. I have a curious theory that if they could not breathe they would cease to exist. But perhaps if I had brought out a ventilating nosebag for seven years I should think differently. Are not *you* rather full of chaff, by the way?—W. S.—I quite agree with you that it is a circumstance full of terrible meaning that so many should have applied for that horrible office.

Our Mathematical Column.

MATHEMATICS IN OUR SCHOOLS.*

By Professor Henrici.

Pure geometry seems to me to be of the greatest educational value, and almost indispensable in many applications; but it has scarcely ever been introduced at Cambridge, the centre of mathematics and mathematical education in England.

Geometry and geometrical drawing, which teach how to represent figures on a plane or other surface have been treated as arts unknown at English Universities, and relegated to the drawing office. Instead of this, they ought to be an essential and integral part of the teaching of geometry in connection with the purely geometrical methods. As far as the progress of science is concerned, this neglect of pure geometry in England has been of little consequence—perhaps it has rather been a gain. For science itself it is often an advantage that a centre of learning becomes one-sided, neglects many parts in order to concentrate all its energy on some particular points, and make rapid progress in the directions in which these lie.

But what may suffer, if one side of a science is not cultivated in is the industry which would have gained by its applications. In considering the teaching of any mathematical or other scientific subject, we cannot at the present time neglect the wants of the ever-increasing class of men who require what has been called

* From Prof. Henrici's opening address to the section of Mathematical and Physical Science, British Association.

technical education. Among these, the large number who want mathematics at all require geometry much more than algebra and analysis, and geometry as applied to drawing and mensuration.

The teaching of geometry especially, as judged by the text-books which have come before me, is somewhat deplorable. And this is so, principally, because the spirit of Euclid and the methods of the ancient Egyptians and Greeks, rather than the fundamentally different ideas and methods of modern geometry, still rule supreme; though the latter have had their origin partly in technical wants. In what is called geometrical drawing, or practical geometry, for instance, there are first given a number of elementary constructions—such as drawing parallels and perpendiculars, or bisecting the distance between two given points. They are solved by aid of those instruments only which Euclid knew—viz., the pair of compasses for drawing circles, and the straight-edge for drawing straight lines. But there is no draughtsman who would not, as a matter of course, use set squares for the former problem, and solve the latter by trial rather than by construction. Then again, there come constructions like the division of the circumference of the circle into seven parts, which cannot be solved accurately, but which is very easily solved by trial. Instead of that, a construction is given which takes much more time, and is by no means more accurate. For, after all, our lines drawn on the paper are not without thickness, so that, for this reason alone, every part of the construction is affected by some small error; and it is absurd to employ a construction, though theoretically true for ideal figures as conceived in our mind, in preference to a much simpler one which, within our practical limits, is equally, or perhaps more, correct.

This is very much like the manner in which I found problems on decimal fractions treated by the candidates for the matriculation examination at the London University, and which reflected little credit on the manner in which the important subject of decimals is handled at our schools. It is so characteristic that I may be excused for giving it here. The problem, for instance, being to give the product of two decimal fractions, exact to, say, four decimals, each of the factors having the same number of places, this was almost regularly performed as follows:—First, the decimals are converted into vulgar fractions, then these are duly multiplied, numerator by numerator, and denominator by denominator, and then the resulting fraction is again converted to a decimal, with as many places as it may yield; and, lastly, of these the first four are taken and put down, duly marked "Answer!" Or a candidate (standing, however, on a far higher level) multiplies both decimals out in the proper fashion, but to eight places, and cuts off four places at the end. No wonder that the public at large will hear nothing of the decimal system of weights and measures if the very essence of the decimal system of numbers is so little understood by the men who have to train the minds of the young generation.

It is by the neglect of pure geometry and of its applications to geometrical drawing that Cambridge has lost, or rather has never had, contact with the practical needs of the nation. All the marvels of modern engineering have sprung into existence without its help. The great engineers have had to depend to a degree now unheard of upon costly experiments, until they themselves gradually discovered mathematical methods adapted to their purposes. Only the electrical engineer found ready to his hands a complete theory of which the mathematical part has been to a very great extent developed at Cambridge, or by men who have had their mathematical training there. This theory is, however, in its very nature less geometrical.

The engineer will always prefer geometrical methods to analysis, and has invented for himself a great variety of them. Originally these are disjointed, being invented for special purposes. It is the business of the mathematician afterwards to connect, simplify, and extend them, as has been done to a great extent by Culmann in Zurich, and by Cremona at the Polytechnic School at Rome. Of these methods a few may be mentioned. First of all the geographical determination of stresses in certain girders invented both by mathematicians and by engineers. Its application is so simple that no engineer will ever use any other method if once he knows this one. It is so well adapted to its purpose, that I venture to say that a simpler method is impossible, being fully aware how dangerous such a statement is. Nay, if I were asked to give the formulæ to obtain the stresses by calculation, I should write these down from a sketch of the diagram, this being the simplest way of obtaining them. Another problem which occurs again and again is the determination of the area of a figure representing perhaps a plot of land, or the section of a beam. Here also the advantage is altogether on the side of the graphical method.

It is unnecessary to multiply these examples. But to make full use of graphical methods, the draughtsman ought to have a thoroughly geometrical education.

That the old-established mode of teaching the elements of geometry based on Euclid requires a thorough and fundamental change has been often acknowledged, among others, at Exeter and Bradford, by two of the most eminent mathematicians who have occupied the chair, and besides by the many teachers who constitute the Association for the Improvement of Geometrical Teaching. I have hesitated on entering on this somewhat delicate quesion, because I fear that I have little to offer but criticism, which might seem hostile to the association just named. But I hope that the many earnest workers, who have devoted much time and thought to the drawing up of syllabuses on different parts of our subject will excuse the remarks of one who has himself tried his hand at the same work, and who therefore may be supposed somewhat to know the difficulties that have to be overcome. When the syllabus on the elements of plane geometry appeared, I resolved to give it a thorough trial, and took the best means in my power to form an opinion on its merits, by introducing it into one of my classes. The fact that it did not quite satisfy me, and that I gave up its use again, does not, of course, prove that it fails also for use in schools, for which it was originally intended.

The more I have become acquainted with the difficulty of the whole subject, the greater has become my admiration for Euclid's book, while my conviction of its unfitness as a school book has equally gained in strength. In considering the merits of Euclid as a text-book, it is desirable to distinguish clearly between the general educational value of its teaching and the gain of geometrical knowledge. It is with the latter chiefly that I am concerned, while it is, of course, through the former that Euclid has got so firm a hold at all schools; and to the great majority of boys this is undoubtedly of most importance, and no reform would have the slightest chance of becoming generally introduced which neglects this. But improvement in both directions may well go together, and the logical reasoning employed in Euclid would gain to many boys much, both in clearness and interest, if the subject-matter reasoned about became in itself better understood.

If acquaintance with geometrical objects, particularly through the medium of geometrical drawing and the many methods used in the Kinder-Gartens, were secured, then a systematic course of geometry would become both easier and more useful. Much, indeed, may be done by introducing simple geometrical teaching into the nursery, and into the earliest instruction of children, following the example of the Kinder-Garten, and it is pleasing to see that the latter are rapidly gaining ground in England. It is true that these schools may still be improved. In geometry they seem to, and perhaps at present are bound to, work mostly towards Euclid. But many able men and women are actively engaged in perfecting them, and it is of interest to know that Clifford had it in his mind to write a geometry for the nursery and the Kinder-Garten.

In a curious contrast to the mode of teaching geometry stands that of teaching algebra In the first, everything is sacrificed to logic. Axioms and definitions without end are given, though to the beginner a more rapid dive into the subject would be much more suitable. In algebra, on the other hand, the boy is at once plunged into the midst of it. No axiom is mentioned. A number of rules are stated, and the schoolboy is made to practise them mechanically until he can perform, and that often with considerable skill, a number of most complicated calculations—but calculations which are often of very little use for actual applications. Simplifications of equations follow in senseless monotony, until the poor fellow really thinks that solving a simple equation does not mean the finding of a certain number which satisfies the equation, but the going mechanically through a certain regular process which at the end yields some number. The connection of that number with the original equation remains to his mind somewhat doubtful. Then there are processes, like the finding of the G.C.M., which most of the boys never have any opportunity of using, excepting, perhaps, in the examination room. A more rational treatment of the subject, introducing from the beginning reasoning rather than calculation, and applying the results obtained to various problems taken from all parts of science as well as from everyday life, would be more interesting to the student, give him really useful knowledge, and would be at the same time of true educational value.

The chief progress in geometrical teaching has to be sought in the introduction of modern ideas and methods into the very elements, and modern teaching ought to take full account of this. In favour of this view I might bring forward the opinions of many teachers and mathematicians from England, as well as from abroad, but I will confine myself to one quotation. Professor Sylvester gives his opinion thus: "I should rejoice to see mathematics taught with that life and animation which the presence and example of her young and buoyant sister (viz., natural and experimental science) could not fail to impart, short roads preferred to long ones, Euclid honourably shelved or buried 'deeper than ever plummet sounds' out of the schoolboy's reach, morphology intro-

duced into the elements of algebra — projection, correlation, motion accepted as aids to geometry — the mind of the student quickened and elevated and his faith awakened by early initiation into the ruling ideas of polarity, continuity, infinity, and familiarisation with the doctrine of the imaginary and inconceivable. It is this living interest in the subject which is so wanting in our traditional and mediæval modes of teaching." If from this point of view we now look towards the work of the Association for the Improvement of Geometrical Teaching, the result is not as satisfactory as might have been wished. There is very little of the influence of modern ideas to be found in the different syllabuses which have been published. Even in the one headed "Modern Geometry" there is nothing of the genius of modern thought. The subject-matter is partly taken from modern geometry, but for modern methods one looks in vain. Nevertheless, it is satistisfactory to see that the use of the syllabus on plane geometry has spread pretty widely, and it is to be hoped that it will continue to do so.

A thorough reform, in the direction indicated, will be a difficult task, and it will, perhaps, be a long time before it is possible. At present it has not even been settled which series of axioms will ultimately be adopted. Possibly, many attempts have still to be made before a new Euclid finds the material sufficiently prepared for him to raise the hoped-for edifice.

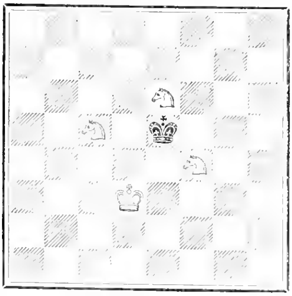
Our Chess Column.

By Mephisto

PROBLEM.—By the Rev. H. Bolton.

The Arabians.

Black.



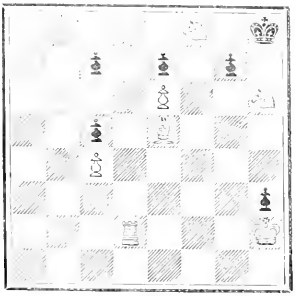
White.

White to play and mate in fourteen moves.

PROBLEM No. 101.

By W. Furnival.

Black.



White.

White to play and mate in three moves.

SOLUTION OF PROBLEM 99.

1. K to KB8. Threatening 2. Kt to Q7 (ch) and 3. Kt (from Kt3) to QB5, mate.

1. Q takes QBP does not prevent this, as the Q will be pinned.

This checkmate position is very beautiful.

Black's defences are Q takes Kt or P takes Kt.

If 1. Q takes Kt. 2. Q to KR2, &c.

If 1. P takes Kt. 2. Q to QR7, &c.

This is doubtless an exceedingly beautiful problem, but there is a slight blemish in the fact that in answer to several of Black's possible *first* moves (viz., P to QR6, P to K7, P to KB6, Q takes Q, Q to B8, Q to Q8, Q to Q7, Q to K7, Q to KB7, Kt to R6, Kt to Q7) White can play either 2. K to K7, or 2. Kt to Q7 (ch). Fritz's problem, however (unnumbered, on page 61), has some dual solutions on the second move. I do not think No. 99 bears away the palm from Fritz's composition. In the former the White K is evidently *wanted* on K7, and the fact that he must not travel by KB7 suggests KB8. In the latter, KR8 is apparently such a useless position for the Queen that one is hardly likely to try it until it is suggested by the failure of Q to KR6 and Q to KR4. The almost exact balance of pieces is also a point (though a small one) in favour of the first prize problem. But the ideas and combinations in both are so elegant that the only reason why Berger's problem is not the best, is that Fritz's is such an uncommonly fine problem. The similarity in the methods of getting the White Q round an awkward corner will not pass unnoticed. W.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. A. Miles.—Problem received with thanks.

Correct solutions received.—Problem 99, John Watson. No. 100, W., B. Gleam, John Watson.

John.—In Problem 99, if 1. Q takes Q, Kt to B6 (a very fine defence). 2. Kt to R5, Kt to Q4. Or, 2. Q takes Kt, P to B6, and there is no mate.

Contents of No. 100.

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KNOWLEDGE
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MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 12, 1883.

CONTENTS OF No. 102.

BRITISH ASSOCIATION SCRAPS.

DR. STONE read a paper on the electrical resistance of the human body. He began by observing that the application of this powerful force to the organism in a scientific manner was still in embryo, and that the results had hitherto fallen far below what might be expected. The main difficulty in obtaining this resistance lay, first, in the difficulty of making good contact through the skin of a living man, and, secondly, in the rapid electrolysis which takes place in the tissues when a current passes through them. The resistance of the skin, he thought, had been greatly overstated, and might easily be overcome by very large electrodes saturated with a conducting solution. The electrolysis was checked by alternating contacts and momentary duration of the current. In this way he had obtained very satisfactory results—among others, the interesting physiological observation that a man of 5 ft. 6 in. in height, another of 6 ft. 3 in., and the Hungarian giant, who was 8 ft. high, nearly all gave from the wrist to the ankle a resistance close upon a thousand Ohms, the larger man being decidedly the better conductor. The influence of temperature and of disease was also adverted to, the body apparently following the law of solid conductors, increasing in resistance with heat and becoming a far better conductor when suffering from paralysis than in the condition of health.

DR. STONE also read a paper on some effects of brain disturbance on the handwriting. It was not surprising, he said, that affections of the cerebral hemispheres competent to interfere with the complex co-ordination of speech should also show their influence on the similar act of writing. Essentially both functions were acquirements which by practice had become automatic, and were put forth involuntarily. He said, therefore, that as the defect known as aphasia might occur in different parts of the circuit, so might graphic modifications. Three such cases he described, one of which occurred to himself personally. After sustained mental effort, he fell down in a partial state of insensibility. During three weeks delirium and delusions predominated over physical depression. These were broken, however, by lucid intervals. The leading feature of all his aberrations seemed to have been reduplication. He doubled the number of his sisters, his nurses, and his medical attendants. When he returned to himself and could trust his memory and senses he found two things—first, what he had been accustomed to call aphasia; secondly, that he could not write as he intended. The tendency to reduplication, which was obvious in his delusions, was as clear as need be in his writing, and the trick of including otiose letters in familiar words lasted for some time. It was probably the trace either of mental stammering or of diplographia, depending upon want of synchronism between the two hemispheres of the brain. That such a condition of the ocular muscles occurred in drunkenness was well known.

MR. E. P. CULVERWELL read a paper on the probable explanation of the effect of oil in calming waves in a storm. He said when the surface of the sea had become smooth after a storm it was very common for long rollers to break on a sand-bar. If there were no wind and the sea was glassy, these would not break until quite close to the shore, even though the ordinary theory pointed to their breaking earlier, unless there was a force directed opposite to that of their motion. When exerted on the waves, such a force might be supplied by the wind; but if it rose in any direction the waves broke much sooner. This result was, therefore, due to some secondary effect produced by the wind pressure, and not directly by the pressure itself, and it was to the ripples produced on the surface, which disturbed the wave motion, that the speedy breaking was to be attributed. It was, however, a direct result of the theory that the ripples depended on surface tension for their propagation, and could not exist in large amount on the oiled surface. It was also evident that the hold of the wind on the wave was greatly decreased by the absence of ripples, and thus the oil acted both to prevent the wind having much effect on the surface, and also to modify the motion of the water in the wave.

PROFESSOR STOKES read an important paper by Dr. Huggins on coronal photography without an eclipse. In a paper read before the Royal Society some time back, Dr. Huggins had shown that it was possible by isolating, by means of properly chosen absorbing media, the light of the sun in the violet part of the spectrum to obtain photographs of the sun surrounded by an appearance distinctly coronal in its nature. These researches have been continued, using a reflecting telescope by the late Mr. Lassell, and a film of silver chloride as the sensitive plate, on which the photograph is taken. These plates are sensitive to the violet light only, and therefore it was unnecessary to use absorbing media, which had proved a source of difficulty, to sift the light. Fifty photographs in all were taken and examined afterwards by Mr. Wesley, who made drawings of them for the paper. The details shown agree well with the photographs of the corona made during the late solar eclipse, the agreement being specially marked in two cases, dated April 3 and June 5. The photographs have been seen by the observers sent to Caroline Island to observe the eclipse, and one of these writes that Dr. Huggins's coronas are certainly genuine up to 8′ from the sun's limb. Dr. Ball, who was in the chair, examined some of the plates, and spoke of the interest and importance of this communication.

A NATURALIST'S YEAR.

THE SHREWS DIE.

By Grant Allen.

On every country footpath in October, if only you care to look for them, you will find here and there, at long intervals, the soft furry dead bodies of the pretty little, unobtrusive, English shrew-mice. So commonly are they to be noticed in such situations, indeed, that the country people have (or had) an ancient superstitious belief to account for the fact; they held that a shrew couldn't run across a public path without immediately and incontinently dying. Doubtless the notion was closely connected with that general idea of the uncanniness of the shrew, which is bound up with the incantations of shrew-ashes and shrew-murrain; as a witch-animal, it couldn't show itself on the open, away from the secresy of night, and darkness, and forest shades, without paying the penalty of extinction to the light of day and the broad sunshine: for shrews, like bats, moles, frogs, and lizards, are held as small deer of ill-omen in old-fashioned folk-lore, doubtless because of their retiring habits, and their indirect connection with graveyards, stone monuments, barrows, mounds, and other recognised haunts of ghosts or fairies. To the sober eye of unimaginative science, however, the number of shrews found dead on roads or highways in autumn is merely an index of the far greater numbers which must be scattered about unobserved among the grass of meadows and the tangled undergrowth of the hedgerows, where especially they love to lurk in little shrinking, domestic colonies. So far as one can judge, the shrew tribe is one of those on which the Malthusian problem is always pressing with annual persistence. Like the natives of India, the shrews, in their crass ignorance of political economy, go on increasing with careless improvidence during all seasons when the food supply is abundant, and then get summarily checked again by a vast famine system the moment it begins to fail or diminish. Every spring each female shrew brings forth a litter of six or seven young, and as these are but little checked by natural enemies, owing to their small size and extreme timidity, they find plenty of food throughout the summer, when beetles, worms, slugs, and petty snails abound everywhere among the fields and thickets. But when autumn comes the food-supply falls short, and then the shrews have to be thinned out pitilessly by the inexorable law of nutural selection. Enough, of course, survive to continue the existence of the species undiminished; and as long as that is the case Nature is perfectly satisfied: "So careful of the type she seems, so careless of the single life."

The type, indeed, is one which naturalists at least would not willingly see perish. Like as the shrews are in external appearance to the smaller rodents—so much so that it is a mere bit of purist scientific affectation to speak of them otherwise than as shrew-mice—they are really insectivores of the purest water, and in no way truly related to the rats and mice. Their close outer similarity depends entirely upon adaptive resemblance; it is one more instance of the common law that plants or animals of very similar habits acquire very similar external shapes, however great their real underlying differences of descent. In other words, the same circumstances which have modified the central rodent form into the little harvest mice and field voles have also modified the central insectivorous form into the shrews and their allies. Now, the great evolutionary interest of the shrews consists in the fact that they are themselves in many ways the most primitive and unspecialised insectivores at present existing. Taking the small insectivorous group as a whole, it is remarkable for the extreme divergence and high specialisation of most of its members: though the entire number of living insectivores is but very few, they yet have to be divided into some ten or twelve distinct families, some of which are marked off from the others by highly developed external modifications. For example, we have within this single group such unlike animals as the hedgehog, with his spiny coat and his habit of rolling himself up into a closely-bristling ball; the underground mole, with his small half-buried eyes, his thick coat of peculiar fur, his strong digging paws, and his long pointed muzzle; the squirrel-like bangsrings of the Malay Archipelago, with their big bushy tails, their arboreal habits, and their active, restless disposition; the pretty little jumping elephant-shrews of South Africa, like kangaroos in miniature, semi-erect on their tall hind legs, and possessed of extremely thin proboscis-like muzzles; and, finally, strangest of all, the big, floundering colugo or galeopithecus—the "flying lemur" of early biologists—with its wide parachute membrane between the limbs and body, and its bat-like trick of gliding lightly through the air from one tree or branch to another. This extraordinary variety of external form within the limits of a single small group like that of the insectivores, almost irresistibly suggests the idea that we have here the last feeble remnants of a once wide-spread and important mammalian order. The great mass of the connecting links have apparently died out, and have left the few existing genera of insectivores either as nocturnal, or subterranean, or aquatic creatures in the great continents, or else as solitary denizens of outlying insular or peninsular regions.

A rapid glance at the present distribution of the principal modern insectivores will show this probability far more clearly than any amount of mere reasoning would do. The colugo, for example, lingers on in the Malay Peninsula, Sumatra, and Borneo,—just the sort of places in which stray members of decadent groups are always found. The bangsrings and their allies are also almost peculiar to the Malayan region. The elephant shrews belong chiefly to South Africa, long a separate insular district, as Mr. Wallace has shown, with a very antiquated local fauna of its own. The hedgehogs, though far more cosmopolitan in their distribution (so far as the old world is concerned) are yet marked as outlying members of a dying family by a large combination of features—they have survived by virtue of their prickly defences, their nocturnal habits, their prowling life, and their burrowing instinct: and one very primitive form of hedgehog—which is, in fact, almost shrew-like in most of its peculiarities, and possesses only the merest rudiments of spines—is confined to the very isolated Malayan region, where it has loitered in the early shape without any modification; while its more hardly-pressed neighbours in the great continents have all been weeded out, unless possessed of very spiny prickles, till now they have assumed the familiar form of the common English hedgehog. Another closely-related family, that of the tanrecs, is all but wholly confined to Madagascar, that fertile nurse of ancient types, elsewhere superseded; the only exceptions are those of two similar little animals—the solenodons, one of which inhabits Haiti, while the other is found nowhere but in the tropical jungles of Cuba. It is a very significant fact that allies of this ancient Mascarene family should turn up thus unexpectedly in the West India Islands. Whenever we find closely allied species thus isolated in two remote and peculiar habitats, with no other of their congeners intervening, we may reasonably conclude that the group to which they belong was once far more widely dispersed over the globe, but that they have gradually been superseded in

the intermediate districts. Still more clear does this conclusion become when the existing habitats are in islands or peninsulas, when the animals themselves are clearly archaic in type, and when the intermediate districts are actually inhabited by more advanced and distantly related animals, like our own hedgehogs. Other isolated insectivorous families are the golden moles, now confined entirely to South Africa, and the potamogale, a peculiar West African river shrew. Our own moles and their kind are even more generally distributed than the hedgehogs, being found in the northern half of both hemispheres, though never spreading south of the equator; and they have clearly been preserved by their subterranean habits, for which they have undergone such marked specialisation of structure and function. All these instances, then, combine to show us that the insectivores are really a decadent order, surviving for the most part only under two sets of conditions—either in islands and peninsulas, far from the fierce competition of the great continents; or, if on the continents, then under special circumstances of life—nocturnal, subterranean, or aquatic—where they have been spared the competition in its worse forms, or have been endowed with special modes of defence by spines or bristles, which enable them to hold their own somehow against otherwise better adapted competitors.

Of all the insectivores, however, the shrews are the most central and least differentiated existing kind; and it is this fact which gives them their deepest claim to respect in the eyes of the evolutionary naturalist. For the insectivores themselves, as Professor Huxley has long insisted, are, in many respects, the most central order in the great division of mammals above the marsupials—the Placentata of most modern authors. Hence we may say, without exaggeration, that the shrew comes nearer than any other existing animal to the prime ancestor of the whole superior mammalian stock. There are many points, indeed, in which some of the abnormal and very archaic isolated insectivores strongly recall the marsupial type, and especially that of the phalangers. Thus the shrews are by no means remotely related on the one hand to the extremely ancient pouched animals, the most primitive (geologically speaking) of all known mammals; while, on the other hand, the curious isolated forms preserved for us in distant islands bridge over the gap to the hedgehogs and the bangsrings, as well as, perhaps in a less degree, to the carnivores, the lemurs, and the bats. Thus, the shrews in particular, and the insectivores in general, may be regarded as the great central junction of the entire mammalian line, whence the various diverging side-lines branch off in different directions towards all the chief families and orders of mammals, up to the lions, the elephants, the horses, the bats, the monkeys, and even man himself.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XX.

In my last I described generally the diffusion of liquids, and the actions to which the names of *endosmosis* and *exosmosis* have been given. It is easily seen that in extracting the juices of meat by immersion in water the work is done by these two agencies. This is the case whether the extraction is effected by maceration (immersion in cold water) or by stewing.

Some of these juices, as already explained, exist between the fibres of the meat, others are within those fibres or cells, enveloped in the sheath or cell membrane. It is evident that the loose or free juices will be extracted by simple diffusion; those enveloped in membranes by exosmosis through the membrane. The result must be the same in both cases; the meat will be permeated by the water, and the surrounding water will be permeated by the juices that originally existed within the meat. As the rate of diffusion—other conditions being equal—is proportionate to the extent of the surfaces of the diverse liquids that are exposed to each other, and as the rate of osmosis is similarly proportioned to the exposure of membrane, it is evident that the cutting-up of the meat will assist the extraction of its juices by the creation of fresh surfaces; hence the well-known advantage of mincing in the making of beef-tea.

It is interesting to observe the condition of lean meat that has thus been minced and exposed for a few hours to these actions by immersion in cold water. On removing and straining such minced meat it will be found to have lost its colour, and if it is now cooked it is insipid, and even nauseous if eaten in any quantity. It has been given to dogs and cats and pigs; these, after eating a little, refuse to take more, and when supplied with this juiceless meat alone, they languish, become emaciated, and die of starvation if the experiment is continued. Experiments of this kind contributed to the fallacious conclusions described in No. 6 of this series. Although the meat from which the juices are thus completely extracted is quite worthless *alone*, and meat from which they are partially extracted is nearly worthless *alone*, either of them becomes valuable when eaten with the juices. The stewed beef of the Frenchman would deserve the contempt bestowed upon it by the prejudiced Englishman if it were eaten as the Englishman eats his roast beef; but when preceded by a *potage* containing the juices of the beef it is quite as nutritious as if roasted, and more easily digested.

Graham found that increase of temperature increased the rate of diffusion of liquids, and in accordance with this the extraction of the juices of meat is effected more rapidly by warm than by cold water, but there is a limit to this advantage, as will be easily understood by referring back to No. 3, in which is described the conditions of coagulation of one of these juices—viz., the albumen, which at the temperature of 134° Fahr. begins to show signs of losing its fluidity; at 160° becomes a semi-opaque jelly; and at the boiling-point of water is a rather tough solid, which, if kept at this temperature, shrinks, and becomes harder and harder, tougher and tougher, till it attains a consistence comparable to that of horn tempered with gutta-percha.

I have spoken of beef-tea, or *Extractum Carnis* (Liebig's Extract of Meat), as an extreme case of extracting the juices of meat, and must now explain the difference between this and the juices of an ordinary stew. Supposing the juices of the meat to be extracted by maceration in cold water, and the broth thus obtained to be heated in order to alter its raw flavour, a scum will be seen to rise upon the surface; this is carefully removed in the manufacture of Liebig's extract or the preparation of beef-tea for an invalid, but in thus skimming we remove a highly-nutritious constituent—viz., the albumen, which has coagulated during the heating. The pure beef-tea, or Extractum Carnis, contains only the kreatine, kreatinine, the soluble phosphates, the lactic acid, and other non-coagulable saline constituents, that are rather stimulating than nutritious, and which, properly speaking, are not digested at all—*i.e.*, they are not converted into chyme in the stomach, do not pass through the pylorus into the duodenum, &c., but, instead of this, their dilute solution passes like the water we drink directly into the

blood by endosmosis through the delicate membrane of that marvellous network of microscopic blood-vessels which is spread over the surface of every one of the myriads of little upstanding filaments which, by their aggregation, constitute the villous or velvet coat of the stomach. In some states of prostration, where the blood is insufficiently supplied with these juices, this endosmosis is like pouring new life into the body, but it is not what is required for the normal sustenance of the healthy body.

For ordinary food, all the nutritious constituents should be retained, either in the meat itself or in its liquid surrounding. Regarding it theoretically, I should demand the retention of the albumen in the meat, and insist upon its remaining there in the condition of tender semi-solidity, corresponding to the white of an egg when perfectly cooked, as described in No. 1. Also that the gelatine and fibrin be softened by sufficient digestion in hot water, and that the saline juices (those constituting beef-tea) be *partially* extracted. I say "partially," because their complete extraction, as in the case of the macerated minced-meat, would too completely rob the meat of its sapidity. How, then, may these theoretical desiderata be attained?

It is evident from the principles already expounded that cold extraction takes out the albumen, therefore this must be avoided; also that boiling water will harden the albumen to leathery consistence. This may be shown experimentally by subjecting an ordinary beef-steak to the action of boiling water for about half an hour. It will come out in the abominable condition too often obtained by English cooks when they make an attempt at stewing; an unknown art to the majority of them. Such an ill-used morsel defies the efforts of ordinary human jaws, and is curiously curled and distorted. This toughening and curling is a result of the coagulation, hardening, and shrinkage of the albumen as described in No. 3.

It is evident, therefore, that in stewing, neither cold water nor boiling water should be used, but water at the temperature at which albumen just begins to coagulate—*i.e.*, about 134°, or between this and 160° as the extreme. But here we encounter a serious difficulty. How is the unscientific cook to determine and maintain this temperature? If you tell her that the water must not boil, she shifts her stewpan to the side of the fire, where it shall only simmer, and she firmly believes that such simmering water has a lower temperature than water that is boiling violently over the fire. "It stands to reason" that it must be so, and if the experimental philosopher appeals to fact and the evidence of the thermometer, he is a "theorist."

The French cook escapes this simmering delusion by her common use of the "bain-marie" or "water-bath," as we call it in the laboratory, where it is also largely used for "digesting" at temperatures below 212°. This is simply a vessel immersed in an outer vessel of water. The water in the outer vessel may boil, but that in the inner vessel cannot, as its evaporation keeps it below the temperature of the water from which its heat is derived. A carpenter's glue-pot is a very good and compact form of water-bath, and I recommend the introduction of this apparatus into kitchens where a better apparatus is not obtainable. Some ironmongers keep in stock a form of water-bath which they call a "milk-scalder." This resembles the glue-pot, but has an inner vessel of earthenware, which is, of course, a great improvement upon the carpenter's device, as it may be so easily cleaned.

One of the incidental advantages of the *bain-marie* is that the stewing may be performed in earthenware or even glass vessels, seeing that they are not directly exposed to the fire. Other forms of such double-vessels are obtainable at the best ironmongers. I have lately seen a very neat apparatus of this kind, called "Dolby's Extractor." This consists of an earthenware vessel that rests on a ledge, and thus hangs in an outer tin-plate vessel; but, instead of water, there is an air space surrounding the earthenware pot. A top screws over this, and the whole stands in an ordinary saucepan of water. The heat is thus very slowly and steadily communicated through an air-bath, and it makes excellent beef-tea; but, being closed, the evaporation does not keep down the temperature sufficiently to fulfil the above-named conditions for perfect stewing. At temperatures *below the boiling-point* evaporation proceeds superficially, and the rate of evaporation at a given temperature is proportionate to the surface exposed, irrespective of the total quantity of water; therefore, the shallower the inner vessel of the *bain-marie*, and the greater its upper outspread, the lower will be the temperature of its liquid contents when its sides and bottom are heated by boiling water. The water in a basin-shaped inner vessel will have a lower temperature than that in a vessel of similar depth, with upright sides, and exposing an equal water surface. A good water-bath for stewing may be extemporised by using a common pudding-basin (I mean one with projecting rim, as used for tying down the pudding-cloth), and selecting a saucepan just big enough for this to drop into, and rest upon its rim. Put the meat, &c., to be stewed into the basin, pour hot water over them, and hot water into the saucepan, so that the basin shall be in a water-bath; then let this outer water simmer—very gently, so as not to jump the basin with its steam. Stew thus for about double the time usually prescribed in English cookery-books, and compare the result with similar materials stewed in boiling or "simmering" water.

THE SUN'S DISTANCE.*

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

(*Continued from page* 199.)

It has often been observed that at a meeting of the British Association the proceedings assume a certain tone in harmony with those branches of science with which our President for the time being has been specially identified. In recognition of this principle, which is both useful and appropriate, the first method which I shall allude to this evening is the exquisitely beautiful mathematical calculation by which the distance of the sun can be elaborated from ordinary observations of the planets systematically conducted at our national observations. This method was foreshadowed in the dynamical theory of Newton, and was wrought to perfection by Leverrier. It is based upon the great law of gravitation, and is intimately connected with the splendid discoveries in planetary perturbation which form so striking a chapter in modern astronomical discovery. There is a certain relation between two quantities, which, at first sight, seem quite independent. These quantities are the mass of the earth and the distance of the sun. It follows from the measurements of the intensity of gravitation on the earth's surface, and from the known revolution of the earth around the sun, that the sun's parallax has a determined ratio to the cube root of the mass of the earth. There is no un-

* A discourse delivered at the second general meeting of the British Association at Southport.

certainty about this result, and the consequence is obvious. If we have the means of weighing the earth in comparison with the sun, then the distance of the sun can be immediately deduced.

How, then, are we to place our great earth in the weighing scales? This is the problem which Leverrier has shown us how to solve, and he does so by invoking the aid of the planet Mars. If Mars in his revolution around the sun were solely swayed by the attraction of the sun, he would, in accordance with the well-known laws of planetary motion, follow for ever the same elliptic path. At the end of one century, or even of many centuries, the shape, the size, and the position of that ellipse would remain unaltered. Fortunately for our present purpose, a disturbance in the orbit of Mars is produced by the earth. Although the mass of the earth is so much less than that of the sun, yet the earth is still large enough to exercise an appreciable attraction on Mars. The ellipse which Mars follows is not always the same. The shape of that ellipse and its position gradually change, and the position in which the planet is found depends upon the mass of the earth. The place in which the planet is found can be determined by observation; the place which the planet would have had if the earth were absent can be found by calculation. The difference between the two is due to the mass of the earth, and when it has been measured the mass of the earth can be ascertained. The amount of displacement increases from one century to another; but, as the rate of growth is small, ancient observations are necessary to enable the measures to be made with accuracy.

A remarkable occurrence, which took place more than centuries ago, enables the place of Mars to be determined with great precision. On the 1st of October, 1672, three independent observers witnessed the occultation of the star ψ Aquarii by the planet Mars. The place of the star is known with accuracy, and hence we are provided with the means of accurately defining the point on the heavens occupied by Mars on the day in question. From this result, combined with the modern meridian observations, we learn that the displacement of Mars by the attraction of the earth has in the lapse of two centuries grown to about five minutes of arc (294 seconds). It has been maintained that this cannot be erroneous to the extent of more than a second, and hence it would follow that the earth's mass is determined to within one three-hundredth part of its amount. If no error were present, this would give the sun's distance to about one nine-hundredth part part, which approaches very closely to the limit we have indicated.

Notwithstanding the intrinsic beauty of this method, and the very high auspices under which it has been introduced, it will, I think, hardly be found to fulfil all the needful conditions. We make no impeachment of the fidelity of the observations, and we feel no doubt that the displacement of the planet is mainly, if not entirely, due to the disturbing effect of the earth's attraction; but it seems quite impossible to be sure that some other cause, minute though it must be, may not also have contributed to the result. We cannot be absolutely sure that the theory is above suspicion. Interesting and beautiful though this method may be, we must rather regard it as a striking confirmation of the law of gravitation than as affording an accurate means of measuring the sun's distance.

Several other methods have been employed by which we can place the earth in the weighing scales. Perhaps none of these methods is free from objection as a means of measuring the sun's distance. I must, however, mention one of them which has special claims on our attention of a very peculiar kind.

This time we invoke the aid of that erratic member of our system known as Encke's comet. The comet completes a circuit around its ellipse in a period but little more than three years. It does not, however, move with uniform velocity. Around the remote part of its path the comet creeps languidly; but as it turns round and commences to approach the sun the pace gradually improves, and the comet itself swells up in dimensions and in splendour. Encke's comet, although so famous, is one of that numerous host of telescopic objects which seldom or never become bright enough to be visible to the unaided eye. It can only be seen when comparatively close to the sun. All around the outer part of its path it i totally invisible in the most powerful telescope. The comet itself is shown here. It is a dull hazy spot of light, evidently composed of materials of a filmy, or almost spiritual texture. A great comet is usually attended by a long tail. This small telescopic comet is not so decorated.

Notwithstanding the insignificance of Encke's comet, it is capable of giving us very interesting information acquired during its somewhat eccentric travels through the solar system. It is, for instance, able to weigh the earth, and thus to afford the means of measuring the sun's distance. The elliptic path which the comet describes is, of course, mainly due to the preponderating influence of the sun's attraction. If there were no source of disturbance the comet must follow that eclipse inflexibly and never deviate therefrom. But the planets insist on asserting their power, the orbit of the comet is disturbed, and that orbit is so eccentric that the disturbances occasionally attain to enormous dimensions.

For instance, when the comet draws near the sun it passes very close to the track of Mercury. It has happened that the comet arrives at Mercury's orbit at the same moment that Mercury arrives at the comet's orbit. Such a *rencontre* may bring the comet and the planet within a couple of million miles, which is quite an insignificant distance in measures of this description. In such a case the comet and the planet attract each other with vehemence. The solid mass of Mercury drags the comet from its path, though the flimsy and unsubstantial comet can impress no measurable disturbance on the movements of Mercury. In its outward career the comet sometimes approximates to Jupiter, in which case the great planet contributes its potent aid to the derangement of the comet. The earth, also, although its path lies more distant from the track of the comet is still able to contribute a little further disorder, so that the path which the comet really pursues is one of amazing complexity. It is the task of the astronomer to survey that path, to determine its shape and its position, and to ascertain the epochs at which the comet accomplishes each successive stage on its never-ending journey.

This work being done, the problem is now one for the mathematician. It is for him to decompose the complicated movement into its constituent elements. He discriminates first the great elliptic motion due to the attraction of the sun. Superimposed on the elliptic motion he finds the smaller and more perplexing movements due to the planetary disturbance. He can disentangle the effect due to the earth's attraction from that due to Mercury and to Jupiter. This work has been done in a masterly manner by the late distinguished Russian astronomer Von Asten, and he has elicited the mass of the earth from a most recondite inquiry, embracing some twenty complete revolutions, during which the comet has been observed. It would, however, be unwise to assign much weight to the distance of the sun, which may be deduced from these researches. Notwithstanding the labours of many astronomers, the

theory of the comet's motion is still not sufficiently perfect for this purpose. It cannot be pretended that this method would give the sun's distance to within a thousandth part, and accordingly this method must give place to those which have more claims to accuracy.

(To be continued.)

Editorial Gossip.

Mr. Herbert Spencer has shown the scientific aspect of systems of government, so I need not apologise for touching on the subject here. Now our Constitution is our pride, the glory of our British hearts. Never did man so offend our race as when Prince Albert told us that the British Constitution was on its trial. In theory how beautiful it is. Each man has power, if he but earn decent wages, to take a part in the management of matters—a little part but still a part. Then the management of matters by the State is so providently extending itself to matters with which the State might be supposed to have nothing or little to do! The State has been awfully unlucky (let us put it that way) in the management of matters it might have left alone. But still our people have a touching confidence in the perfect wisdom of the legislature, its power to arrange just right such things as hitherto it has singularly mismanaged. Yet it is a little odd, slightly perplexing to those who look at matters from without, to find that individual members of the elected body of lawmakers, are for the most part, when standing in the position of candidates, considered no wiser or better than their fellows—nay, strangely enough, these embodiments of national wisdom, are usually denounced in the roundest (but by no means the rosiest) terms before election. Somehow the elected body differs utterly in kind from the same set of men when as yet unelected.

But this is not all that perplexes the student of the matter. Among the elect, we see rather more than one-half starting off at a pace which the rest find rather too fast or rather too slow, and that as a result of this diversity of views, each section finds the other section contemptible and hateful,—the more pronounced on either side being more hated and despised, despising also and hating more intensely, than their fellows, but every representative of the collective wisdom regarding much more than half of his fellows as exceedingly unwise. Our daily papers so carefully teach us that whole sections of our collective wisdom are hateful and despicable, while they so completely represent (among them) *every* section, that the general effect to outsiders is depressing—one might almost say (not using the word in any offensive sense) distressing. How other nations are impressed one may guess by considering how we ourselves, after steady daily reading of American papers for a few months, learn to revere the Congress, Senate, and Legislature of our cousins over the water. An Englishman by keeping close to one party paper may learn to believe that among a section of the representatives of his people there is a little honesty and a little sense. But if by chance he should take up the wrong paper he will find even that one section vilified so unsparingly that he will not know what to think (though foreigners may). But perhaps, he may think, among the real leaders of the two chief sections, or of their sub-divisions, there may be none of this feeling of hatred and contempt. Even this hope is denied the thoughtful Briton however, when, reading the words of one who is supposed to be a chief leader of the section which as it chances is not now having its innings, he comes on such words as these, "There is work for us all and a place in the ranks for each of us, in face of *the common enemy*,"—the "common enemy" being simply the other section of the collective wisdom which the nation asks so confidingly to manage its business. The masts of the State ship may be perhaps made firm and strong by stays tautened well on opposite sides; but to tell the crew that all the port shrouds are rotten (or all the starboard ones, as the case may be), is not encouraging; while to go further and to tell the starboard watch that the best thing they can do is for each to help in cutting the port shrouds, is beyond measure mischievous if those shrouds are sound and as good as giving up the ship if they are really as rotten as asserted. If each of the chief sections of our Houses of Parley is really regarded by the other as the "common enemy," one should be rather disposed to wonder that constitutional government still *remains* "on its trial."

The amusing confidence with which Mr. Charles Mackay, in the *Pall Mall Gazette*, asserts that the word *Masher* is derived from the Irish *maise*, similarly sounded (!), and meaning an "exquisite" or *petit-maître*, would seem to suggest that he was present when the word was first used, and had carefully traced its subseqent spread in America. It was "introduced by the Irish immigration," he tells us. If so, the case is an interesting one; for the Irish who speak the old language have not been able to introduce many of their words into common use among Americans, and their talk would not be very commonly about dandies. "In strange contrast with the Dandiacal Body," says Carlisle, "stands" that other sect, "originally of Ireland," and there known "by a perplexing multiplicity of designations such as *Bog-Trotters*, *Redshanks*, *Ribbonmen*, *Cottiers*, *Peep-of-Day Boys*," &c. That members of this sect should have brought into use an American slang word for dandies is so unlikely that one could hardly believe it, even if there were no other probable derivation of the word.

But while, to begin with, the word "maise" is not pronounced like "masher" (except to rather dull and uncritical hearing) and while, to go on with, the word "masher" as first used in America did not signify dandy, the derivation of the word is so obviously American that it would be as absurd to go to a foreign language for it as it would be to seek some Norse or Arabic origin for the familiar term "Crusher." The word "masher" was first used in America, and in 1879 (when I first noticed it in American papers) was constantly used as almost the equivalent of our term a "lady-killer," and was applied especially to a class of fellows who made themselves obnoxiously obtrusive to ladies travelling alone. It was only later that it was used to indicate the general style of costume employed by these offensive persons, and gradually lost a portion (only) of its originally contemptuous meaning. As the word "mash" is used in America to signify crushing, hurting (something between pinching and smashing), the suitability of the word "masher" is obvious. Just as we speak of a "lady-killer," a "killing dress," a "crushing costume," and so forth, a dandy dressed to kill and going about like a braying jackass seeking whom he may molest with impertinent addresses, is (or rather was) called contemptuously a "masher." There was more bitterness than fun in the early use of the term. It does not appear in Bartlett's

"Dictionary of Americanisms," fourth edition, 1877. But it began to be used about that time. It had been earlier applied by the profession (stage) to those who wished to be actress-killers.

A poem suggested by four of my lectures on astronomy has come to me this week. My usual rule has been to have no poetry in these columns, although there are some subjects of scientific study which seem to lend themselves very suitably to poetic treatment. In the present case, an exception has been made, to which I trust readers will not take exception.

VOICES OF THE SUNS.*

By Vega.

I WATCHED the depths of darkness infinite
Bestrewn with stars, till dreaming I beheld
From out the mystic realms beyond my ken
A star come forth with even gliding rush :
Till sweeping onwards shone its orb
With all the mighty meaning of a sun,—
A sun girt round by many-peopled worlds,
And worlds as yet not peopled being young,
And worlds long since unpeopled being old
And dead. Their ruling sun shone on them—
On the living, on the yet unfashioned,
On the dead : on all it shone, though idly
Where as yet life had not sprung from forth
The teeming womb of time ; and idly too
Where life had ceased to be. On all those worlds
The mystic force which lives in matter worked
Its mighty will. Dead worlds and worlds scarce born
And worlds alive with myriad forms of life
Swept circling round that stately ruling orb.
As it sailed past I heard its solemn voice
Proclaiming through the realms of space the song,
The everlasting song of Life and Death—
Of wealth of Life and everduring waste
And dearth of Life. It sang of present, past,
And coming plenitudes of Life ; of past
And coming wastes of Death : infinitudes
At once of Life and Death ; each without end,
Without beginning each. "Along my path—
In front," it said, "and backwards whence I came—
And all around, above below my course,
Lie millions such as I, through endless realms
Of star-strewn space. There is no end to God's
Domain of suns and systems ruled by suns—
No end and no beginning through all space—
But everlasting, mystic, wonderful,
The song of us sounds ever round the throne
Of Him who reigns supreme, the Life of All—
Unknown ! yea evermore Unknowable !"
Then as the Psalmist sang of old I said—
Because, so moved, I could not choose but speak—
"What Lord is man that Thou should'st care
For him or for his kind, the son of man that Thou
Should'st mindful be of him or his ?" Then rang
A voice of solemn thunder through the spheres
"Say rather, What is Space or Time to Me,
That thou should'st deem mere mightiness of mass
And plenitude of time can outweigh mind
And soul ? Can worlds and suns My power know ?
Can æons after æons sing My praise as man
Gifted by Me with power to know My power, can tell
The meaning of the music of My spheres ?
Then I said, "Nay Lord, but if the words
Of men are worth the utterance, they are thine.
Lo we are but the creatures of Thy hand.
We see but part of all Thy wondrous work.
Could we but see the glory of Thy Light,
Could we but hear the thunder of Thy Power,
We should become both blind and deaf—
Deafened by strident tones, made blind by light.
In Thee alone we live and move, in Thee
We have our being. But shall we, finite, hymn
The praises of Thine Infinite ? Shall weak man,
The creature, paint with erring brush the Sun
Of Might and Power and Wisdom evermore supreme ?"

* * * * *

The answer came, "Shalt thou, My creature, doubt,
Or hold My Will in question ? Learn that the least
Of all the minds My Will has made
Outweighs not once but many thousand times
The mightiest mere mass : the thoughts of human hearts
Outvie the movements of a million suns,
The rush of systems infinite through space.

* Lines suggested by four lectures on Astronomy (Birth and Death of Worlds, The Sun, The Moon, and The Star Depths).

WEATHER FORECASTS AND HOW TO MAKE THEM.

By John Browning, F.R.A.S.

THE RAIN-BAND SPECTROSCOPE.

THE rain-bands are like the Fraunhofer lines, at right angles to the spectrum, but instead of being sharply-defined, they are simply shaded bands, which appear darker as rain becomes imminent. When they are very prominent they are more conspicuous than any of the Fraunhofer lines.

Almost the only difficulty experienced in using the spectroscope for observing the rain-band is that of knowing where to look for the band or bands in the spectrum.

By using the spectroscope in the manner now to be described, and carefully consulting the engravings here given, I trust this preliminary difficulty will be avoided. Take the spectroscope in the left hand, and looking through the eye-piece *with the sliding tube towards the eye*, direct the instrument towards a white cloud at about 20° or 30° above the horizon, that is, at about from one quarter to one-third of the distance from the horizon to the zenith, or, in other words, overhead. If the instrument has an adjustable slit, close the jaws by turning the largest milled ring at the opposite end to the eye-piece from left to right, while you are looking through it, until lines begin to appear in the direction of the *length* of the spectrum. Then slowly and carefully open the jaws of the slit until these horizontal lines disappear. Now turn the red end of the spectrum towards the left, and examine the coloured riband of light graduating from red through orange, yellow, green, and blue into violet, known as the spectrum.

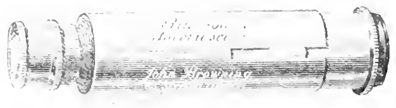


Fig. 1.

Just where the red and yellow meet in the spectrum there is a fine line across the spectrum which is known as the D line. In the ordinary rain-band spectroscope (Fig. 1)

this line appears single, but with the slit shut as closely as possible, and the light from the sky very strong, when the observer is possessed of good eyesight, it is just possible to see that this D line is really double—the finest imaginable line of light appearing exactly in the middle of it, and thus dividing it into two.

D

Fig. 2.

Whenever there is moisture in the air which is likely to fall as rain, this D line (or lines) appears thicker and blacker, and on the side towards the red there is a shaded band from two or three to five or six times the breadth of the D line. This band has been named the *rain-band*. If this band is very dark and broad, and is visible when the spectroscope is directed towards the sky, at an angle of 45°—that is half-way between the horizon, and directly overhead—then rain may be confidently expected in from six to twelve hours.

In Fig. 2 I have given an engraving of the D lines in the spectrum when there is no rain-band present, and in Fig. 3 an engraving of the spectrum, with a very strong rain-band showing in it such as I have just described, as indicating that rain is imminent. The two strong lines in the shading to the left of the D will not be shown by any low-power spectroscope of the ordinary construction.

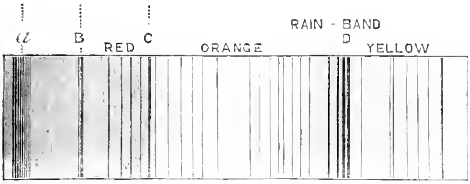


Fig. 3.

It must be understood that this band may appear of any degree of intensity, from even darker than it is shown in Fig. 3, to the faintest sign of its presence in the spectrum.

Some little practice is necessary to estimate the intensity of the rain-band; but this knowledge is generally soon acquired.

To fairly estimate the probability of rain and the time at which it may be expected, it is necessary to observe carefully the intensity of the rain-band at different degrees of elevation above the horizon.

An hour or two after sunrise there is mostly a slight rain-band visible near the horizon. This I should call *a low, faint rain-band*. It would be wrong to conclude that this appearance will be necessarily followed by rain. It is a good plan to make rain-band observations about nine o'clock in the morning, and to observe most particularly, when the rain-band is seen, how high up in the sky it is visible.

In estimating the intensity of the rain-band, Mr. Rand-Capron gives a series of diagrams of the rain-band, six in number, and refers all his observations to one of these, estimating the variation in its intensity to about from fifteen to twenty per cent.

Mr. Corry, who has written some excellent letters to Knowledge on this subject, assures me that after only a few weeks' practice, he had no difficulty in estimating its intensity to ten per cent.

I find for beginners it is sufficient to estimate the intensity to twenty-five per cent., according to four degrees of intensity, of which Fig. 3 may be considered as the third, equalling seventy-five per cent.

I cannot get diagrams engraved on wood of sufficient accuracy and delicacy to represent even these four degrees of intensity.

The diagrams given are, for wood-cuts, by far the best I have seen, and do the engraver great credit; but even their preparation to my satisfaction has caused a month's delay in the appearance of these articles.

I have referred first to the shaded band only in the spectrum, because this only is shown in the simplest and most inexpensive spectroscopes.

Professor Piazzi-Smyth, who first suggested the use of the spectroscope for predicting rain, used an exceedingly powerful and costly instrument for the purpose, in which the rain-band was shown *as a number of separate lines.*

LINES IN RAIN-BAND

Fig. 1.

RAIN-BAND.

Fig. 5.

Thanks to the ingenuity of Mr. Grace, we are now provided with a portable spectroscope at a very moderate expense, which will clearly show the two principal *lines* in the rain-band. These two lines are shown in the diagram, Fig. 4, and again, with the shading by which they are always accompanied when they are strong, in Fig. 5, and also in Fig. 3. The ordinary small spectroscope will

Fig. 6.

not, I repeat, show these *lines*. Grace's spectroscope is shown in Fig. 6. Until I was able to supply this instrument, a great number of my correspondents were not able to *see*, let alone estimate, the intensity of the rain-band.

In my next article I shall refer to the angle of disappearance of the rain-band, the best method of making and recording observations, and the practical conclusions to be deduced from them.

EPHEMERA, OR DAY FLIES.

THESE insects belong to the family which is scientifically called Ephemeridæ. They are called day flies on account of their short life, a single day sometimes witnessing their entrance into a perfect state of development and their death. They pass about two years in their larval and pupal state.

These insects are interesting and remarkable for a stage of development which is very uncommon. When they forsake the water where their larval and pupal state is passed they creep out of the pupa case, and after resting for a short period—from one to twenty hours—begin a tremulous motion of their wings. Then they fly to the

trunk of a tree, or to the stem of some water plant, and cast off a thin membranous skin, which has enveloped the body and wings; and fly quickly away before the eyes of the observer, leaving this skin resting upon the stem, looking at first like a dead insect. After this operation the wings are much brighter. The state between leaving the water and casting off the skin is called "pseudimago."

These day flies were known to the ancients. Aristotle says "that about the time of the summer equinox he observed on the shore of one of the rivers which empties into the Bosphorus, little sacs, from which insects would creep out and fly about until evening, then grow weary and die at the setting of the sun. They were called on this account day flies."

On a quiet May or June evening these insects may be seen flying about, sometimes in great numbers, their gauze-

like wings irradiated by the rays of the setting sun. They fly without any visible motion of their wings, and seem to drink in joy and pleasure in the few hours which lie between their appearance and disappearance, their life and death.

They measure from 17 to 19 millimètres without the tail filaments, which in the female are of the same length as the body, but in the male double the length.

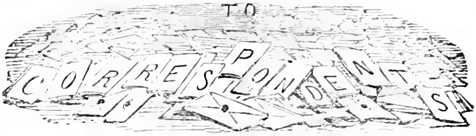
The larvæ inhabit the water, and have upon each side of the back part of the body six tufts or tassels; the head runs forward into two points, and has fine hairy feelers; the legs are smooth, the front ones the strongest, and adapted for digging. They are fond of hiding under stones or burrowing into the sandy shores, and make a very curious tunnel, something like a double-barrelled gun, which is often 52 millimètres deep.—*From Brehm's "Animal Life," Scientific American.*

THE FACE OF THE SKY.

From Oct. 12 to Oct. 26.

By F.R.A.S.

The telescope should be directed to the Sun on every clear day. The aspect of the night sky may be gathered from Map X. of "The Stars in their Seasons." Mercury is now a morning star, and, about the time of his greatest western elongation from the Sun on the 22nd, may be seen near the horizon before sunrise somewhat to the south of east, by any one who will get up soon, or sit up late enough for that purpose. Venus, for all practical purposes, continues invisible. Mars gets slowly larger; but his angular diameter only amounts to 8″·8 by the 26th, so that very little in the shape of detail is visible upon his face. He rises about 10 h. 21 m. p.m. on the 26th. Jupiter will be in so-called "Conjunction" with Mars on the night of the 19th Jupiter being about 59′ to the south of him. As both planets are so close together in the sky, it is needless to add that they are equally indifferently placed for the observer. Saturn, rising sooner and sooner every night, will be above the horizon about 6h. 19m. p.m. by October 26. His superficial details can now be studied very advantageously. Uranus is invisible; but Neptune, as we said a fortnight ago, may be found as a small 7th mag. star to the S. and E. of δ Arietis. The age of the moon to-day at noon is 11·3 days and pretty obviously, on the 26th it will be 25·3 days. During the early morning of the 16th there will be a partial eclipse of the moon. The first contact with the penumbra (or faint edge of the Earth's shadow) will occur at 1h. 42·4m. a.m. The first contact with the real shadow, at 5h. 59·1m. a.m., and the middle of the eclipse at 6h. 54·3m. a.m., Greenwich mean time. Before this, though, the moon will have set. If we call the moon's diameter 1, only 0·277, or less than three-tenths of it, will be covered at the time of greatest obscuration. Two occultations only of fixed stars by the moon will occur during available hours within the next fourteen days. The first is that of the 6th mag. star B.A.C 1272, which will disappear on October 18 at the Moon's bright limb at 7h. 48m. p.m., at an angle of 36° from her vertex, to reappear at her dark limb at 4h. 35m. p.m., at a vertical angle of 267°. The second occultation happens on the 21st, when one minute after midnight λ Geminorum, a star of the $3\frac{1}{2}$ mag., will disappear at the moon's bright limb at a vertical angle of 55°. It will reappear from behind her dark limb at an angle of 216° from her vertex at 1 h. 2m. a.m. on the 22nd. The Moon will be in Aquarius all day to-day and to-morrow until about 8 p.m., when she will cross the boundary into Pisces. It will be four o'clock in the afternoon of the 16th before she has completed her path across this great constellation, and entered Aries. She will reman in Aries until 4 a.m. on the 18th, at which time she will cross the boundary into Taurus. Her path through this constellation will occupy until 1 p.m. on Saturday 20th, when she will pass into the northern part of Orion. She will be until two o'clock the next morning crossing this, and will then enter Gemini. Here she will continue until six p.m. on the 22nd, when she enters Cancer. She will not quit Cancer until 10 a.m. on the 24th, when she crosses into Leo. Some twenty-four hours later she descends into Sextans. About seven a.m. on Oct. 26 she re-enters Leo, and is still crossing that constellation at midnight on the 26th.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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PONS'S COMET.

[953]—The comet that was first detected by Brooks, on September 2, and subsequently seen by Mr. Wendall, of Harvard College, and also at Lord Crawford's observatory, Dunecht, was observed by me in Liverpool, on the night of October 3; its right ascension being 16h. 14m. and declination north 55° 25′, therefore it is about 3° 22′ south-west of η Draconis; from this data its position can easily be determined by reference to Proctor's "Star Atlas."

Seen through a 30-inch achromatic, with a magnifying power of 60, it presented the appearance of a globular vaporous disc, showing a slight degree of condensation towards the centre—no stellar point could be discerned with the power employed. A star (of about the 9th magnitude), which shows no diminution in brilliancy, can be seen shining through the nebulous edge of the cometary disc.

It is supposed to be identical with Pons's comet of 1812, which has a period of about seventy-two years. W. K. Bradgate.

SOFTENING WATER.

[954]—In a guide to the Fisheries Exhibition now before me, I find an allusion to Atkins's process of softening hard water, "which turns lime in solution into a solid bi-carbonate."

Would you or any one of your intelligent readers kindly inform me of the nature of this process. Lewis James.

HULL-DOWN SHIP.

[955]—Referring to the query of "H. A. L. S.," No. 951, page 219, I think Mr. Proctor has missed the correct explanation. I have little doubt that the disappearance and reflection described was caused by a layer of air of *less*—not of *greater*—density than that above it. It is a well-known law in optics that light cannot pass from a medium of higher into one of lower refractive power at anything beyond a certain degree of obliquity. When this obliquity is exceeded, total reflection occurs, the rarer or less refracting medium is absolutely opaque to the incident rays, though the film of this medium be no thicker than gold-leaf.

If at the time when "H. A. L. S." made his observation the sea was warmer than the air above, such a film of warmer air would be in contact with the surface of the water, and the rays coming from the hull-down ship would strike the bending horizon surface at the maximum of possible obliquity, and, therefore, suffer total reflection. A portion of the sea itself would thus be hidden and replaced visually by a mirror-like surface easily confounded with the sky beyond.

This is rarely seen over an unbroken sea horizon, but is an every day (*i.e.*, every sunny day) phenomenon wherever there is a stretch of sea bounded by an horizon of gradually sloping land, especially if that land be rocky and dark coloured, like the glaciated islet rocks on the Arctic coast of Norway. There the air, heated by contact with the warm rock, renders the rock itself invisible up to a certain height, and makes it appear as though suspended in the air.

This form of mirage is curious in itself, but I have observed something else connected with it that is still more curious, viz., that sailors and fellow-tourists to whom I have pointed it out had never observed it before, though they must have seen it hundreds or thousands of times. In "Through Norway with a Knapsack,"

I describe it in detail, and show how it explains the sea-serpent of the old Norsk traditions; not the puny thing of a few hundred feet long described by modern observers, but the veritable Kraken, three or four and more miles long. I saw him myself, of such dimensions, and have pictured him in the last edition (1876) of that work.

W. Mattieu Williams.

[Mr. Williams's explanation seems to me scarce consistent with the observed phenomena. A film of rarer air would have shown the rest of the upper masts, sails, &c. So would a film of denser air; but in this latter case the sea horizon and surface would be seen, and the reflected masts, &c., *below* the sea horizon would be lost—as was, in point of fact, the case. Of course if the film were limited in extent part of the upper rigging would be lost; but the parallelism of the observed sea limit with the true horizon would in that case be only explicable as a most marvellous coincidence.—R. P.]

SIR WILLIAM HERSCHEL.

[956]—I have only just seen letter 917 (p. 219), in a locality between 200 and 300 miles from my own library. Under these circumstances I really cannot say, off hand, the name of the work in which I found the statement as to the loss of an eye by Sir William Herschel; but, immediately on my return home, I will hunt up the reference and give it (as Colonel Herschel requests) in these columns, for the benefit of all interested in the matter.

A Fellow of the Royal Astronomical Society.

SMALL WHEELS *v.* LARGE WHEELS.

[957]—I have received so many letters from cyclists who have read my articles in Knowledge stating that they agree with what I have written on this subject, that I propose briefly replying to "Sigma's" last letter, and then withdrawing from the farther discussion of this question.

With regard to the pace travelled by Mr. Marriott I had assured myself before writing, by comparing notes with a tricycling sporting expert, that the pace made by Mr. Marriott on the 40-inch "Humber" was faster than he travelled on the 42-inch "Humber" on a more level road in far better condition.

It was also faster, slightly, than Lowndes made over a better course on a "Coventry:" but if it had been slower, surely "Sigma" must see that would have had but little bearing on the matter.

The performance of the same man on the same class of machine first with large and then with smaller wheels is the criterion.

There is nothing in "Sigma's" suggestion that probably the "Humber" alone among tricycles may run better for having small wheels.

Mr. Salmon, as he stated in his lucid letter in last week's Knowledge, has been led to adopt small wheels from his experiments with a Coventry Rotary, Mr. Grace has done so after experimenting with rear-steerers of the "Meteor" type, while Mr. Howard and myself have used front-steerers of the "Salvo" type, and we have all arrived at the same conclusion.

Small wheels are certainly at no disadvantage in hill-riding, as compared with large wheels.

"Sigma" gives us one experiment he made with 44-in. wheels. I have tried hill riding on fifty machines, and I can ride Godstone-hill, the steepest incline I care to ride, on my 38-in. Humber, geared to 46-in., easier than on any other machine.

I can easily produce a witness that I have quite recently done this on the 38-in. machine if "Sigma" doubts my word.

I do not in any way refer to this as a feat, but name it because I have been compelled to dismount on this hill on every other machine but my 38-in., though that is geared to 46-in., while I have failed to ride it with 48-in. wheel machines geared down as low as 36 in. I have also failed to ride it on a 44-in. "Humber" geared level, by which I do not mean that I could not have struggled up, but that I preferred to dismount rather than run the risk of breaking a blood-vessel.

These systematic experiments prove to me conclusively that small wheels are at no disadvantage in hill-riding.

Mr. Salmon is correct in supposing that my articles in Knowledge are not written for the guidance of racing men, or even hard riders, but for those who are content to ride at a moderate speed, with a pleasurable amount of exertion.

If any novices should follow "Sigma's" advice and attempt to ride over hills with machines geared up to 60 inches, they will probably soon give up riding, voting it simple slavery. I write advisedly, for I have reconciled several men to riding who were about relinquishing it, by having their machines geared down to 46 inches when I found they were trying to ride machines with 50-in. wheels *geared level*, and in every instance, I believe, they were stronger men than myself.

I have a friend—a strong man and a good oarsman. Some time since he got a machine from a dealer. After riding for a few weeks he sold it. On inquiry I found it was a machine with 50-in. wheels geared up to 56. I did my best to persuade him to try another machine geared down, but he had been sickened. He replied that he was not afraid of work, but tricycling was something more than work, it was—and he said something with a very big D indeed.

Contrary to "Sigma's" suggestion in a former letter, I do not find that novices who are set to ride a machine which runs easily at a moderate pace, quickly become disgusted with tricycling.

John Browning,
Chairman of the London Tricycle Club.

P.S.—Mr. Shaw has written another long article in the *Tricyclist*, which I can dismiss in a postscript, as he has only one strong point in it. He asks why I do not propose to ride on geared-up castors? I might, with as much reason, have asked why he did not propose to build machines with wheels 160 in. in diameter instead of 60 in.? But I did not reply to him in this way, because I preferred to meet all his theoretical suggestions by statements of facts, or arguments based on experiments, without descending either to ridicule or even exaggeration.

DR. FRANKLIN'S MAGIC SQUARE OF SQUARES.

200	217	232	249	8	25	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	237	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	211	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

[958]—The chief properties of Dr. Franklin's Square which accompanies this, are as follow:—

1. The sum of the sixteen numbers in each column or row, vertical or horizontal, is 2,056.

2. Every half column, vertical or horizontal, makes 1,028, or just one half of the sum 2,056.

3. Any half vertical row, added to any half horizontal, makes 2,056.

4. Half a diagonal ascending added to half a diagonal descending, makes 2,056, taking these half diagonals from the ends of any side of the square to the middle of it, and so reckoning them either upward, or downward, or sideways.

5. The same with all the parallels to the half diagonals, as many as can be drawn in the great square; for any two of them being directed upward and downward, from the place where they begin to that where they end, make the sum of 2,056; thus, for example, from 64 up to 52, then 77 down to 65, or from 194 up to 201, and from 181 down to 191; nine of these bent rows may be made from each side.

6. The four corner numbers in the great square added to the four central ones make 1,028, the half of any column.

7. If the great square be divided into four, the diagonals of the little squares united make each 2,056.

8. The same number arises from the diagonals of an eight-sided square taken from any part of the great square.

9. If a square hole, equal in breadth to four of the little squares

or cells, be cut in a paper, through which any of the sixteen little cells may be seen, and the paper laid on the great square, the sum of all the sixteen numbers seen through the hole is always equal to 2056.

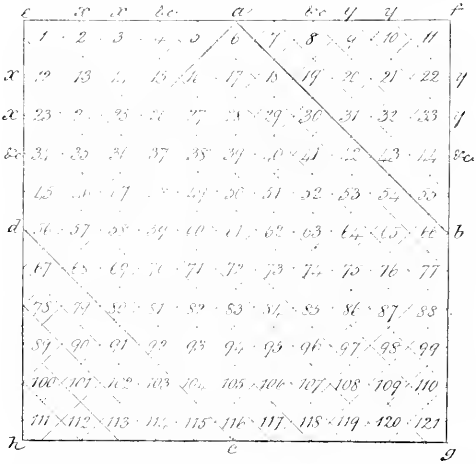
In short, there is scarcely an end to the variety of ways by which 2056 may be made, and to use the constructor's own words, "it is the most magical of all magic squares ever made by any magician."

Clavis.

Copied from *The Mirror* of Oct. 28, 1824.

MAGIC SQUARES.

[959]—It may interest some of the readers of Knowledge to be shown that a "Magic Square" can be made by a very simple mechanical process. Take any square number (with an odd root) of terms in continued arithmetical progression, say 1 to 121, and



write them down in the form of a square, as in the appended diagram. The next step is to inscribe a second square (*a b c d*) in the first. This second square is, of course, just half the size of the first, and will contain one more than one-half of all the terms in the series, *and all in their right places in the proposed square.* Hence it only remains to remove the other terms from the four outside triangles to their respective positions. For convenience draw the diagonals *x x*, *x x*, &c., *y y*, *y y*, &c., and then cut off the four triangles from the inscribed square. Take now one of the triangular pieces, say *a b f*, and place it on the opposite side of the inscribed square, with the side *a b* on *d c*, and the vertex 8 on the centre, that is on the term "61." Dispose of the other three triangular pieces along the corresponding sides; and supposing *transparent* paper to have been used, and the figures to have been accurately arranged, every term will fall into its proper place, thereby completing the "Magic Square." James Macfadzean.

A VERY COMPLETE MAGIC SQUARE.

[560].—"G. S." sends you, and you publish under the above title (888, p. 61), a magic square of nine, which he thinks it would be difficult to surpass. I do not clearly understand what "G. S." means when he says with reference to his square that the number 369 is produced "by the angles, whether right, acute, or obtuse, from the corners or the middle from the centre," but I imagine that he refers to some of the ways of making 369 with four pairs of numbers, each making 82, and the central number, 41, added. If this is so, his square possesses only two properties which do not belong to all magic squares; the first, that each of the nine small squares makes 369; and the second, that each number with the number opposite to it makes 82. The latter property gives a choice of four out of forty pairs of numbers, which, with 41, make 369. This choice can be made in 91,390 ways; and yet this property is not at all a rare one, or one which makes a magic square particularly curious. It is found in the magic squares made by the very simple rules of Moschopulus and others, and also in squares not magic, made by writing the numbers down in their natural order.

Let me now offer you a magic square of nine, which contains all the properties that I could discover in "G. S.'s" square and some others.

1	44	78	46	62	15	64	26	33
68	21	34	5	39	79	50	57	16
54	58	11	72	22	29	9	40	74
6	37	80	51	55	17	69	19	35
70	23	30	7	41	75	52	59	12
47	63	13	65	27	31	2	45	76
8	42	73	53	60	10	71	24	28
66	25	32	3	43	77	48	61	14
49	56	18	67	20	36	4	38	81

Additional properties of this square:—

1. If one or more rows be transferred from top to bottom, or from one side to the other, or both, the square will still be magic. In other words, all the *broken* diagonals make 369; a broken diagonal being a set of numbers beginning with one in the top, and running diagonally to one side, then entering on the opposite side in the next lower line and running diagonally to the bottom.
2. In any square, whether that given above or one formed by transfer of rows, any nine numbers forming a square make 369.
3. In the small squares into which the above square is divided, each horizontal or vertical row of three numbers makes 123, one-third of 369. A.

[For the present magic squares are done with.—R.P.]

LETTERS RECEIVED AND SHORT ANSWERS.

An Inquirer. There is no evidence showing that "the seasons are not what they used to be twenty or thirty years ago;" but when you hear any one say that, you may safely conclude that he (or she) is not what he (or she) used to be twenty or thirty years ago.—G. Jinman. A happy shot, but made pretty safely.—An Old Woman. Sorry to hear Mr. Jago mistaken in thinking all Liverpool bread good.—Geologist. Know of no such work.—F. C. Dixon. Know nothing about blow-pipe, but believe some blow-trumpet articles are appearing in the weekly you mention.—Clash. Newcomb's explanation of the tides unsound. The usual theory is statically correct, but the true theory is the dynamical one, for sketch of which see Sir E. Beckett's "Astronomy without Mathematics." Do not know where you can get photographs of the sun. Gall's projection not known to me.—Jas. K. Thornexton, Glasgow. My dear (but atrabilious) sir, you are the solitary survivor (I fancy) of the foolish folk among Knowledge readers who mistake fun for fury. I thought we had got rid of the last of you. Your weekly twopence would be *far* better bestowed on *Pilul. Antib. (Cockl.)*.—F. Cowley. I don't think I promised explanation, only comment. No one can conceive space of four dimensions or more. Would not mind some pretending they can if they would not waste so much time and thought about it.—Vega. Hitherto I have found no place for poetry, of which a good deal has been sent me. If I make an exception in your case it is because of the bearing of your ideas on my own views, with which (by the way) they are not so inconsistent as many might imagine. The lines shall appear; but the case must not be regarded as a precedent. If readers should approve of the lines, however, the others of which you speak may perhaps find a place. I do not consider myself a judge—for a reason you will understand.—A Stargazer. How odd that your letter should come next! Your stanzas (as you call them), beginning "The stars so bright! The stars so bright! How beautiful they shine!" &c., would scarcely suit these columns, even if poetry were in general admissible here, which is not the case. Yet the last lines are profoundly touching, and quite merit your notes of admiration:—

With folded hands! Aye, folded hands! and likewise down-bowed head!
I gazed upon the glowing orbs that shone high overhead!
I mused upon those mystic orbs till day came and they fled!

I can understand the folded hands (you should have kept them so) but a down-bowed head hardly suits one who is gazing on stars *overhead*. Your rhyming also is a little shaky; but the same fault may perhaps be found with the following little poem which has

been suggested by your "Stanzas" (note also that your impressive use of italics is followed):—

The Village Green! the Village Green! How beautiful it is!
I saw a goose upon it, with melancholy phiz!
    I saw a goose upon it! and she waddled to and fro!
    Yes, to and fro! Aye, to and fro! And likewise fro and to!
She waddled so, I could not tell if she were one or two!

Muse on the mystic meaning in the last line. The goose must have waddled pretty fast, I admit; but the thing is at least as possible as gazing on stars with down-bowed head. The velocity of revolution indicated in the following lines is far greater:—

There was a man from Yankee land
  Who round a walnut tree,
Did run so fast—that lissome man—
  His own back he could see!

—Personne. Pardon me, no one here has denied that compositors do good and useful work in pointing matter not properly punctuated by the author. Sir E. Beckett expressly called attention to the point, in his remarks on the comma. There is scarcely a writer who does not give the compositor work of this kind. If calling attention to the annoyances which arise from point-peppering means want of due recognition of compositors' care in pointing your plea is good enough: but then it does not. Your friend "a compositor of thirty years' experience" calls attention to certain inconsistencies in punctuation which he has noted in Knowledge. They are chiefly "printer's errors" overlooked by author in proof correction; or (in the case of two articles) overlooked by "reader," for these articles were not seen in proof by the author. I might as reasonably insert a letter calling attention to every case of imperfect type, inverted letters, p for p, d for d, and so forth. With regard to the position of) outside or inside "period," comma, or ?, I leave that to compositors, not deeming the matter worth contesting. But what your friend thinks a redundancy—the use of both a comma and a dash,—is no redundancy at all: his remarks on that point show that he has no idea of the real use of the dash. A comma, a dash, and a comma *plus* a dash, mean three different things. When you throw in words not distinctly parenthetical, where if the words were omitted no comma would come in, you use the dash only; but if a comma would come in, the introduction of the dashed in words does not justify the omission of the comma. When but one dash is used, as where words are thrown in at the end of a sentence, one should use a dash only or a comma and a dash, according to the degree in which one may wish the reader's mind to pause, so to speak, before it considers the added idea. One may even find it well, in certain cases, to use a semicolon and a dash. The colon and dash have a special and well-known use. In passing, I may note that in some cases a paragraph may conveniently be closed with a colon instead of a period. I could point to many cases in which for want of this or some other way of indicating connection between two successive paragraphs (rightly put as separate paragraphs, however) the opening sentences of the second are perplexing: really carrying on the idea dealt with in the first paragraph, they are read as if introducing a new idea. See especially De Morgan's "Budget of Paradoxes" for cases in point. Lastly, if your friend cannot see a good reason why in the sentence "It is singular, too, how along with meanness," &c. a comma should be set each side of the too, whereas in the sentence "This too may sometimes be seen &c." no commas are wanted, all I can say is that I can very well understand how it happens that he remains a compositor after so many years' experience.—F. J. F. Have not tried the system.—Aqua Pura. Do not know which is the best filter for domestic use.—W. E. Crowther. Thoroughly agree that hygiene should be made a subject of special instruction; but cannot find room even for an abstract of so long a letter. R. H. Ricurs. Thanks. Subject suitable, but now no space.—W. B. Thanks. Yet I think the Rigmarole inventor scarcely meant *that*. I have forgotten whether his letter came under my attention or not. Think not.—H. Ossipoff. If the matter were really one for discussion and the person who has adopted that name would keep to discussion, it might be done. But as a matter of fact, that person knows perfectly well that his pretended system is baseless. There is also not a single argument in his book which should perplex you. Here is one simple proof that the whole system is absurd. Were it true, the sun, as you can see from his own illustrations, would vary enormously in apparent size during the day. Your own eyes should show you then that the theory is nonsense,—very well as a catchpenny, but not really held by the writer and lecturer who defends it. The other person, poor fellow, is not responsible: he really thinks the theory true: imagine what sort of a mind his must be!—E. W. Barton. Thanks for very amusing extract from *Manchester Courier*: well hit, *M. C.*!—W. G. Woollcombe. Perhaps some reader can name good and reliable books in French and German, on Geometry of Two Dimensions, and Higher Plane Curves.—W. Butler. Alas, have never seen, nor therefore used, that particular telescope.—Uncertain. Let us try to understand each other. You raised the question—What is natural and what is supernatural? I admitted the perplexing nature of such an inquiry, and later expressed the belief that so metaphysical a subject would not interest readers and ought not to occupy space here. You find in this evidence of a wish to burke freedom of speech. Now I think you must know very well that if I have not inserted your remarks on a very difficult and not particularly interesting question it is not because they are personally distasteful to me. I have to omit nine-tenths at least (I expect 99-100ths would be nearer the mark) of what is sent for insertion in the Correspondence columns; and quite a large proportion of what is so omitted is full of interest for me, and often agrees pretty closely with my own views. I agree with a good deal that you say. I am not very clear you may not be right and I wrong where I differ from you. I may be wrong even in thinking most of our readers would not be interested by an inquiry dealing with so perplexing, so shifty a matter as the true place of the defining line between what is natural and what would be supernatural. I can only act to the best of my judgment. But omitting your communication involves no interference with your freedom of speech. If many are interested in the matter you can readily find your audience. As to the question you have raised there are certain properties of matter and certain laws according to which these properties act under various conditions; some of these properties and laws have been determined, many have not, but the properties and laws are there all the same: I take it that the supernatural is in ordinary thought distinguished from the natural in this, that while everything which happens consistently (whether provably so or not) with the actual properties and laws of matter, is natural, any event not consistent with these properties or laws is supernatural. An event may seem supernatural which is really natural. A Labouchere will regard as a miracle what a Carpenter would regard as consistent with the laws, known or unknown, of matter. But an event would be really supernatural, if for its occurrence, the properties and laws of matter had to be temporarily changed or held in suspense.—W. H. Collins. (1) I agree with you that 288 is a value of x satisfying the equation $\sqrt{x+1}+\sqrt{2x}=7$: there is no occasion to write $-\sqrt{x+1}$; for -17 is a value of $\sqrt{289}$. (2.) Prof. Cayley meant, I suppose, that Mr. Glaisher had completed the determination of the factors of the missing three millions out of the first nine million numbers.—H. G. A. Brown. There is certainly no fault to be found with your readiness as a writer, and your freedom of diction. But the article is rather long for what it aims to establish (in which, by the way, I quite agree with you), that in making room for science in education we ought not to exclude literature or become too scientific. As that freed fellow says in the Andria, the rule in such matters should be *Ne quid nimis*. Only he said it rather more laconically than your article.

Our Chess Column.

By Mephisto

SOLUTION.

Problem No. 100, p. 208.

1. B to B2 (disc ch)	1. Q takes Q
2. Kt to Q7 (ch)	2. Q takes Kt
3. Kt to B7 (ch)	3. Q takes Kt
4. R to Kt5 (ch)	4. Q to Q4
5. P to Q4 (ch)	5. P takes P (en p ch) mate

Chess playing is practised in different ways. There are persons who find their enjoyment in playing what are usually termed skittling games. To a casual observer it may seem that the mere moving of the pieces constitutes sufficient amusement for them. To these frivolous devotees of the game, Chess playing serves merely as a mechanical pastime. Such players may, however, be quite as fond of the game as the more serious class, who love to dive into the depths and intricacies of Chess, and who find their intellectual enjoyment increase in proportion to the difficulties of the game. Chess then becomes an intense mental exercise, a struggle of mind against mind.

We have a well founded belief that the struggle is not decided

purely by the relative chess skill of the players. We believe that *a strange influence of mind over mind is also exercised on some rare occasions*, and that this influence materially affects the result of a game.

A common kind of influence has frequently been experienced by many Chess players. Who has not met an opponent whose peculiar play or personality influenced the result of a game played with him? If you happen to meet an opponent who is all smiles and compliments, and of such extreme modesty as to hold up your own play as being beyond praise, while he evinces a corresponding contempt for his own weakness, then be very careful lest you be beguiled into believing him and taking it easy, for you are sure to lose. Another person, who may be a dull and cautious player, will tire you out and thus win a proportion of games quite beyond his Chess strength. Again, there is something irritating in the style of some players, which prevents you doing justice to yourself. We were much amused on one occasion when one day playing both a father and his son, we found the son to be a better player than his father. Our surprise was, therefore, great on learning that the son received the odds of a Knight from his father, and that the latter often won. In all these cases the influence admits of a natural explanation. We are conscious that our senses are affected, as in the above instances, by being either beguiled, wearied, elated by a firm belief in our own superiority, &c. This we will call a conscious or natural influence.

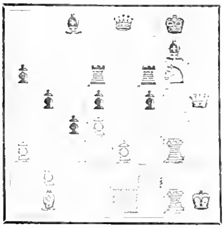
There is, however, another and more powerful influence exercised upon us on rare occasions, which apparently does not operate through the medium of our senses, but in an unconscious manner, which as yet admits of no natural explanation.

This supernatural,* or extraordinary influence of one mind over the other might perhaps be traced in the match between Steinitz and Blackburne. The latter, one of the foremost players of our time, and who has subsequently proved himself nearly the equal of his opponent, as is well known lost seven games without winning or drawing any, in spite of having had several won games in hand. Here we are confronted with a problem which admits of no other plausible solution but that the seriousness and intensity of match play had called forth some influencing power which hopelessly conquered an opponent, who, in the less serious encounters of tournament play, was quite capable of holding his own against the same adversary.

From our own experience we have reason to believe that in some positions an intense desire or will that your opponent may not play a certain move will sometimes unexpectedly be rewarded with success. Only on this theory can we explain the weakness of some players at a critical moment, who will deliberately make the only possible move in a game which avoids winning. The following examples, from actual play, will better illustrate our meaning.

The result of a game recently played was of the greatest importance to Black, who had a bad game, and strained every nerve to avoid the impending defeat. In the annexed position Black clearly saw that he was lost. White likewise perceived the winning line of play, which was as follows:—

Black.



White.

Kt to K7 (ch)	Q takes Kt (best)
R takes B (ch)	Q takes R
Q to K8 (ch)	K to R2 (best)
R takes Q (ch)	K takes R

Q takes B, and White has a winning advantage.

In spite of clearly seeing this, some strange influence caused White to play Kt to B4, which enabled his opponent to win his Queen by R to R3. White of course perceived that he had made a blunder at the very point of winning. The game then continued as follows:—

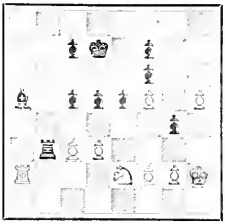
R takes B (ch)	K to R sq. (best)

R (Kt7) to Kt5, with the intention of playing R (Kt sq.) to Kt3, followed by R to R3, which would win (if Black played R takes Q (ch), White would ultimately remain with a piece ahead).

	K to R2 (best)
R to Kt7 (ch)	K to R sq.
R to Kt5	K to R2

Black offered a draw. White, having missed an obvious win—making a blunder instead—should have been well satisfied with the chance of drawing, and not have proceeded with a hopeless game. Incredible as it may seem, White refused the draw—why we cannot tell—and lost.

Black.



White.

The following is also a remarkable instance how a game can be lost. In this position of an important game, Black found himself with a hopelessly lost game. If the Black B retires to Kt3, the White KRP will go on to Queen; or if B takes BP, White will likewise play P to R6, compelling R to Kt sq., and thus winning the B. Applying himself intensely to the position, Black made a desperate effort and succeeded in saving a game in which the chances were at least ten to one against him. Black played:—

	P to K5
P takes P (R takes B would win)	
	P to Q5
P takes P (again missing R takes B)	
	B to K8
Kt to B sq. (weak)	P to Kt6 (ch)
P takes P	B takes P (ch)
K to R3	R to K6
R to K2	B to B5 (ch)
R takes R	B takes R

Now in this position, the game which Black may be said to have pulled out of the fire, ought to have been drawn by correct play, but, as in the foregoing example, it was not to be drawn, for apparently *Black had made up his mind to win*. White played P takes P, upon which, of course, followed B takes Kt, and White resigned.

We do not wish to be misunderstood as saying that one man has it in his power to win a game by the mere exertion of his will. We merely have cited a few out of many remarkable examples how in extreme cases defeat has been turned into victory, and where play on one side has been so obviously and persistently bad as to exclude an explanation of momentary weakness or oversight. We therefore feel justified in suggesting as a plausible cause of some of these surprising results the influence of mind over mind, or the power of will. But this strange influence is as yet an unsolved mystery to the wisest, and we do not hope nor attempt to convince where better men have gained naught but sneers and disbelief.

* Anything being beyond the known laws of nature.

ANSWERS TO CORRESPONDENTS.

, *Please address Chess Editor.*

Stettin.—Solution incorrect.

W. Furnival.—Solutions correct. Please use English notation.

Alpha.—1. Article "How to Construct a Problem," was published in No. 52, of October 1882; you can obtain it by applying to the publishers. 2. Miss Beechey's Chess.

Blossoms.—Solution incorrect.

Squire.—In Problem 101, If 1. B takes P. P takes Kt, and there is no mate.

Problems received with thanks from Berrow and E. N. Frankenstein.

C. Bennett.—See reply to Squire.

E. F. B.—If R to B2 and B6, then the KP takes R, and there is no mate.

No. 101.—By R. Champ, Berrow, Squire. The Arabian by W.

Contents of No. 101.

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CONTENTS OF No. 103.

BRITISH ASSOCIATION SCRAPS.

Mr. B. H. Inglis Palgrave, President of the Section of Economic Science, made the following suggestive remarks at the close of his address: The old age of the honest working man should be made secure against distressing want or degrading relief, and the power of obtaining rational pleasures should be provided for him within reasonable bounds. The question for the economist to consider is—How far can it be granted without impairing the great principle of self-help? This is a point too frequently ignored; but, considering the condition of many of our working classes, their prospects in this country, and the openings which our colonies and the United States promise to energetic industry, we must be prepared to offer better terms than we hitherto have done to those who continue to dwell here. Legislation, conceived in a somewhat similar spirit, has recently been determined on in the German Empire; and if the iron spirit of Prince Bismarck has felt it needful to yield this concession to popular feeling, it would not seem improbable that other statesmen may have, willingly or otherwise, to travel in the same road. There are limits, however, to the application of this class of payments by the State which must be borne in mind. Mr. Fawcett is careful to enforce this warning. The real incentive to labour and economy is individual interest. Self-help is the best help. The question how far the principles usually included under the denomination of Socialism should be taken into consideration by the State is one economists would do well to consider. The economist who sees that the happiness of the community can only be secured by causing individuals to submit to restraints which are irksome and perhaps painful should not be termed cruel for pointing out what is essential to the general well-being. A community which is not prosperous can scarcely possess all the elements essential for happiness. Economic science, like all other branches of science, is governed by certain laws. These laws must be adhered to, though it may not be possible to affirm of them that they are always more than relatively true. Economic teaching is the natural utterance of the most fervent patriotism, and possesses the sanction even of a more serious authority.

Mr. Litton Forbes stated that the territory of Arizona is now practically opened up for the first time in its history by the completion of the new Atlantic and Pacific Railway. The port of Guaymas, on the Gulf of California, probably in the not far distant future will be the port of arrival at least for mails and passengers bound eastward from Australia, China, and Japan. At present Guaymas is a small Mexican town, consisting of adobe houses. Its harbour is excellent—one with deep water up to the very shore, and well sheltered from every wind. It is the only possible mail station on the Gulf of California, and is some 500 miles, or nearly two days' steaming, nearer Australia than San Francisco. Of all the western territories, Arizona has long been the most remote and inaccessible, and, therefore, the least known of all the territories. The aridity of the climate and the presence of hostile Apache Indians have had much to do with this. Arizona is a country of extraordinary mineral wealth. In many parts of its extensive territory it offers large tracts of excellent land to the farmer and the stock-raiser. Its chief drawback is a want of water, but this can be supplied by irrigation works and by artesian wells. Coal, salt, and the precious metals exist in larger quantities probably than in any of the Western mining territories. The copper mines are even now the richest known. The area of the territory is about 114,900 square miles, or approximately 73,000,000 acres—in other words, three times the size of the State of New York. The general topography of the country is that of a plateau, sloping towards the south and west from an altitude of 7,000 feet to the sea-level. The surface of Arizona is much diversified, and contains some of the finest scenery in North America. In no country in the world can the evidences of past geological action be better studied. The cañon of the Colorado is a stupendous waterwork chasm, 400 miles long and from a quarter of a mile to a mile and a quarter in depth, and the scenery in many parts is grand and impressive.

A note on some recent astronomical experiments at high elevations on the Andes was contributed by Mr. Ralph Copeland. At La Paz (elevation 12,000 ft.), he saw stars with the naked eye, when the moon was full, that are with difficulty seen in Europe without artificial aid. At Puno (12,500 ft.), Canopus, Sirius, and Jupiter were visible to unaided vision from one to twenty-five minutes before sunset. A number of small planetary nebulæ and stars, with very remarkable spectra, were found in the southern part of the Milky Way, by searching with a prism attached to a 6-in. telescope on Professor Pickering's plan. The most remarkable stars showed spectra of little more than two bright lines, one near D, and one beyond F, with a wave length of 467 mmm., which the author, in conjunction with Mr. Lohse, had observed in the spectra of various nebulæ; γ Argûs is a star of this type, with the addition that the line near D is threefold. Several close double stars were discovered. At Vincocaya (14,360 ft.) the solar spectrum was very much increased in brightness at the violet end. The solar prominences were seen with nearly equal ease in C, D_3, F, and $H\gamma$. With a small spectroscope a number of lines were visible beyond H and H_2. The solar corona was not seen, nor were any lines discernible in the spectrum of the zodiacal light, although that light was sufficiently bright to be very obvious when the moon was eight days old.

Dr. Copeland made also several interesting meteorological observations. Black-bulb temperatures up to 205·5 deg. F. were recorded, this being the limit of the tube of the instrument, and not the actual *maximum.*

With the black-bulb thermometer more than 13 deg. above the local boiling-point, the wet-bulb was below the freezing-point. At Arequipa (7,500 ft.), the relative humidity of the air was as low as 20 per cent., and not much higher at other stations. The author believed that an observatory might be maintained with great facility at a height of between 9,000 ft. and 12,000 ft., the night temperature being little below the freezing-point at any season. Beyond that height an increased elevation of 150 ft. roughly corresponded to a fall of the thermometer of 1 deg. F., and a depression of the barometer of 1-10th in., so that at 15,000 ft. very arduous winter conditions were encountered.

Professor Janssen gave an account of his observations on the solar corona, made at Caroline Island during the recent solar eclipse. He stated that in 1870 he had seen, for the first time, dark lines in the spectrum of the corona —indicating, probably, the existence of matter capable of reflecting the solar light. This observation had been confirmed by some observers, while others had failed to obtain evidence of it. He thought that the failure was due to the fact that the telescopes used by most observers had too small an aperture compared with their focal length, so that the amount of light received by the slit of the spectroscope was very small; the luminosity of the corona being very feeble. Dr. Janssen used a lens of 50 centimètres aperture, with a focal length of 150 centimètres to form the image on the slit of the spectroscope, which was one which admitted a large quantity of light. By means of an ingenious arrangement, it was possible to observe with one eye at the spectroscope, while the other noted through the finder the part of the corona examined. Dr. Janssen found a complicated spectrum with many dark lines. In the course of his paper he referred to the measurement by photographic means of the intensity of light, and stated that the corona was about as bright as the full moon. Dr. Schuster thought that the differences observed at different eclipses, as to the existence of dark lines, might be real, and not due to want of illumination. During the eclipse in Egypt he had succeeded in photographing G as a dark line. He agreed with Dr. Janssen in attributing the reflection of the solar light to meteoric matter, and pointed out that near the sun there were no lines, so that there the matter was self-luminous. Professor Stokes was inclined to refer the reflection to the action of small particles of matter shot out from the sun in the form of vapour, but condensed at a distance from its surface, forming, as it were, clouds of minute particles.

Mr. Coutts Trotter, F.R.G.S., sketched the physical geography, natural resources, and character of the inhabitants of New Guinea, in the belief that the interest at present felt in that country is, partly at least, due to the prospect of its becoming a field for European enterprise. The author attributes the prevailing ignorance about New Guinea to causes which have ceased to operate, as the difficulties of the navigation, now minimised by steam, the exclusive system of the Dutch in the Spice Islands, and latterly the diversion of the stream of enterprise towards Australia. After a short summary of discovery and exploration, he traces the geological relations of New Guinea and Australia, showing the date of their separation to be recent, while the palæozoic rocks of the inner ranges are identical with those of the Australian gold-fields. Densely-wooded mountain ranges make the interior difficult of access, though possibly some large rivers as yet unexplored may lead thither. The forests contain magnificent timber, fruits, barks, and gums. The sago palm (about which statistics are given) and sugar may become great staples. There are tracts of land suited for cattle raising and for tropical cultivation; but it is a question how far such lands are unoccupied. The natives have a keen sense of rights in the soil, and probably would not work regularly for Europeans. Perhaps confidence might be created first by establishing trading depots. An active trade is now carried on between the hill and coast villages, but their requirements as yet are very few. Thus, though the resources of the country are great, the chances of immediate profit from their development are doubtful. The mass of the people are Papuans, a negroid race which, variously modified, extends throughout Melanesia. Their religion consists mainly of reverence for ancestors, and a fear of the spirits of the dead. They show marked artistic taste in the decoration of their houses, weapons, &c. The eastern peninsula of New Guinea is partly occupied by a wilder race, with Polynesian affinities. Their relations with English explorers have been exceptionally good, and it is hoped that steps will be taken to regulate their intercourse with the whites before serious collisions occur. With our great experience much might be done in this respect, and the protection thus afforded to the people would more than compensate for interference with individual liberty. The Dutch claims over Western New Guinea are vaguely based on those of their dependent, the Malay Sultan of Tidore. His rights have been enforced mainly by periodical raids for tribute and slaves, and it would seem that civilisation has thereby been not only checked, but has retrograded. Disclaiming controversy, the author points out that with the present tendency of matters in the Pacific, and the certainty that the development of New Guinea must be the work of English hands and capital, its separation from the Australian system, to which it naturally belongs, would be a grave political inconvenience. Mr. Wilfred Powell added a number of facts from his own experience. The people were horribly frightened at looking-glasses, thought them a sort of fetish, and threw them away. Sago grew at all known parts of the island. It produced a vegetable fibre which in this country he was offered £35 a ton for. It grew upon a tree in shoots, which were cut when they were about to touch the ground. The cotton of the island was not of much use, as the staple was short and it was filled with small seeds. There were rice and great quantities of rough cinnamon. Eventually there would be a large pearl-fishery. There had been brought from the interior solid blocks of copper ore, and there were precious stones, opals being quite common. The natives were favourably impressed by missionaries, particularly Mr. Charles and Mrs. Laws, and, not knowing anything about convicts, accepted with open arms the French convicts who escaped from New Caledonia. The consequences might be imagined. Torres Straits were almost of as much importance to Australia as the Straits of Dover were to us, but they were filled with islands which would be formidable in the hands of an opponent. It was extraordinary that we had as yet learnt so little about New Guinea, and he hoped that an English expedition would soon explore this *terra incognita*. Mr. H. O. Forbes said the natives were friendly if they were well treated, as they had been by the Dutch, but not by others who were not of that nationality. Mr. Sclater said the island was the home of birds of paradise, of which Count Salvadori had discovered 700 species.

*** The papers on "How to Get Strong," by Mr. Thomas Foster, "Mathematics," and "Whist," will shortly be resumed in these pages.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XVIII.

Widespread as a myth may be, it takes depth of root according to the more or less congenial soil where it is dropped. That about Tell found favourable home in the uplands and the free air of Switzerland; with us, S. George, falling on times of chivalry, had abiding place, as also, less rugged of type than the Swiss marksman, had Arthur, the "Blameless King," who, if he ever existed, is smothered in overgrowth of legends both native and imported.

For such cycle of tales as gathered round the name of Arthur, and on which our youthhood was nourished, is as mythical as the wolf that suckled Romulus and Remus. Modern criticism and research have thoroughly sifted the legendary from the true, and if the past remains vague and shadowy, we at least know how far the horizon of certainty extends. The criticism has made short work of the romancing chronicles which so long did duty for sober history, and has shown that no accurate knowledge of the sequence of events is obtainable until late in the period of the English invasions. Save in scattered hints here and there, we are quite in the dark as to the condition of this island during the Roman occupation, whilst for anything that is known of times prior to this, called for convenience "pre-historic," we are dependent upon unwritten records preserved in tombs and mounds. The information gathered from these has given us some clue to what manner of men they were who confronted the first Aryan immigrants, and, enriched by researches of the ethnologist and philologist, enabled us to trace the movements of races westwards, until we find old and new commingled as one English-speaking folk.

All or any of which could not be known to the earlier chroniclers. When Geoffry of Monmouth set forth the glory and renown of Arthur and his court, he recorded and embellished traditions six hundred years old, without thought of weighing the evidence or questioning the credibility of the transmitters. Whether there was a king of that name who ruled over the Silures, and around whom the remnant of brave Kelts rallied in their final struggle against the invading hordes, and who, wounded in battle, died at Glastonbury, and was buried, or rather sleeps, as the legend has it, in the Vale of Avilion, "hath been," as Milton says, "doubted heretofore, and may again, with good reason, for the Monk of Malmesbury and others, whose credit hath swayed most with the learned sort, we may well perceive to have known no more of this Arthur nor of his doings than we now living."

The comparative mythologists say that he is a myth pure and simple; a variant of Sigurd and Perseus; the winning of his famous sword but a repetition of the story of the Teutonic and Greek heroes; the gift of Guinevere as fatal to him as Helen to Menelaus; his knights but reproductions of the Achaian hosts. Much of which is doubtless true. But the romance corresponded to some probable event; it fitted in with the national traditions. There were struggles between the Kelts and subsequent invaders—Romans, Angles, Saxons, Jutes. There were brave chieftains who led forlorn hopes or fought to the death in their fastnesses. There were, in the numerous tribal divisions, petty kings and queens ruling over mimic courts, with retinues of knights bent on chivalrous, unselfish service. These were the nuclei of stories which were the early annals of the tribe, the glad theme of bards and minstrels, and from which a long line of poets, to the latest singer of the "Idylls of the King," have drawn the materials of their epics. The fascination which such a cycle of tales had for the people, especially in days when the ballad was history and poetry and all literature rolled into one, was so strong, that the Church wisely imported an element which gave loftier meaning to the knightly life, and infused religious ardour into the camp and court. To the stories of Tristram and Gawayne already woven into the old romance, she added the half-Christian, half-pagan, legend of the knights who left the feast at the Round Table to travel across land and sea that they might free the enslaved, remove the spell from the enchanted, and deliver fair women from the monsters of tyranny and lust, set forth on what in her eyes was a nobler quest—to seek and look upon the San Graal, or Holy Vessel used by Jesus at the Last Supper, and into which Joseph of Arimathea collected the blood and water that streamed from the side of the crucified Jesus. This mystic cup, in which we have probably a sacrificial relic of the old British religion imported into the Christian incident with which it blended so well, floated, according to Arthurian legend, suddenly into the presence of the King and his Round Table knights at Camelot as they sat at supper, and was as suddenly borne away, to be henceforth the coveted object of knightly endeavour. Only the baptised could hope to behold it; to the unchaste it was veiled; hence only they among the knights who were pure in heart and life vowed to go in quest of the San Graal, and return not until they had seen it. So to Sir Galahad, the "just and faithful," Tennyson sings how the sacred cup appeared,

> "Sometimes on lonely mountain meres
> I find a magic bark;
> I leap on board: no helmsman steers:
> I float till all is dark.
> A gentle sound, an awful light!
> Three angels bear the holy Grail:
> With folded feet, in stoles of white,
> On sleeping wings they sail.
> Ah, blessed vision! blood of God!
> My spirit beats her mortal bars,
> As down dark tides the glory slides,
> And, star-like, mingles with the stars."

Whilst in such legends as the Arthurian group the grain of truth, if it exists, is so imbedded as to be out of reach, there are others concerning actual personages, notably Cyrus and Charlemagne, not to quote other names from both "profane" and sacred history, in which the fable can be separated from the fact without difficulty. Enough is known of the life and times of such men to detach the certain from the doubtful, as, *e.g.*, when Charlemagne is spoken of as a Frenchman and as a Crusader before there was a French nation, or the idea of Crusades had entered the heads of Most Christian Kings; and as in the legends of the infancy of Cyrus, which are of a type related to like legends of the wonderful round the early years of the famous.

This, however, by the way, since, leaving illustration of the fabulous in heroic story, it will be interesting to trace it through such a tale of pathos and domestic life as the well-known one of Llewellyn and his faithful hound, Gellert.

Whose emotions have not been stirred by the story of Llewellyn the Great going out hunting, and missing his favourite dog; of his return, to be greeted by the creature with more than usual pleasure in his eye, but with jaws besmeared with blood; of the anxiety with which Llewellyn rushed into the house, to find the cradle where had lain his beautiful boy upset, and the ground around it soaked with blood; of his thereupon killing the dog, and then seeing the child lying unharmed beneath the cradle,

and sleeping by the side of a dead wolf, from whose ravenous maw the faithful Gellert had delivered it? Most of us, in our visits to North Wales, have stood by Gellert's grave at Beddgelert, little suspecting that the affecting story occurs in the folk-lore of nearly every Aryan people, and of several non-Aryan races, as the Egyptians and Chinese.

Probably it comes to us as many other tales have come, through collections like the well-known "Gesta Romanorum," compiled by mediæval monks for popular entertainment. In the version given in that book, the knight who corresponds to Llewellyn, after slaying his dog, discovers that it had saved his child from a serpent, and thereupon breaks his sword and departs on a pilgrimage to the Holy Land. But the monks were no inventors of such tales; they recorded those that came to them through the pilgrims, students, traders, and warriors who travelled from West to East and from East to West in the Middle Ages, and it is in the native home of fable and imagery, the storied Orient, that we must seek for the earliest forms of the Gellert legend. In the Panchatantra, the oldest and most celebrated Sanskrit fable book, the story takes this form :—An infirm child is left by its mother while she goes to fetch water, and she charges the father, who is a Brahman, to watch over it. But he leaves the house to collect alms, and soon after this a snake crawls towards the child. In the house was an ichneumon, a creature often cherished as a house pet, who sprang at the snake and throttled it. When the mother came back, the ichneumon went gladly to meet her, his jaws and face smeared with the snake's blood. The horrified mother, thinking it had killed her child, threw her water-jar at it, and killed it; then seeing the child safe beside the mangled body of the snake, she beat her breast and face with grief, and scolded her husband for leaving the house.

We find the same story, with the slight difference that the animal is an otter, in a later Sanskrit collection, the Hitopadesa, but we can track it to that fertile source of classic and mediæval fable, the Buddhist Jatakas, or Birth Stories, a very ancient collection of fables, which, professing to have been told by Buddha, narrates his exploits in the 550 births through which he passed before attaining Buddhahood. In the Vinaya Pitaka of the Chinese Buddhist collection, which, according to Mr. Beal, dates from the fifth century A.D., and is translated from original scriptures supposed to have existed near the time of Asoka's council in the third century B.C., we have the earliest extant form of the tale. That in the Panchatantra is obviously borrowed from it, the differences being in unimportant detail, as, for example, the nakula, or mongoose, is killed by the Brahman on his return home, the wife having neglected to take the child with her as bidden by him. He is filled with sorrow, and then a Deva continues the strain :—

> Let there be due thought and consideration,
> Give not way to hasty impulse,
> By forgetting the claims of true friendship
> You may heedlessly injure a kind heart (person)
> As the Brahman killed the nakula.

The several versions of the story which could be cited from German, Russian, Persian, and other Aryan folk-lore, would merely present certain variations due to local colouring and to the inventiveness of the narrators or transcribers; and, omitting these at the demand of space, it will suffice to give the Egyptian variant or corresponding form, in which the tragical has given place to the amusing, save, perhaps, in the opinion of the Wali. This luckless person "once smashed a pot full of herbs which a cook had prepared. The exasperated cook thrashed the well-intentioned but unfortunate Wali within an inch of his life, and when he returned, exhausted with his efforts at belabouring the man, he discovered among the herbs a poisonous snake."

In pointing to the venerable Buddhist Birth Stories as the earliest extant source of Aryan fables, it should be added that these were with Buddha and his disciples the favourite vehicle of carrying to the hearts of men those lessons of gentleness and tenderness towards all living things which are a distinctive feature of that non-persecuting religion, and thus of diffusing a spirit which would have us

> Never to blend our pleasure or our pride
> With sorrow of the meanest thing that lives.

THE HIMALAYAS AND THE ALPS.*

IN TWO PARTS.—PART I.

We can, in a measure, exemplify the structure of the Himalayas by that of the bones of the right hand, with fingers much elongated and stretched wide apart, of which the wrist and back may represent the broader belt of granitic rocks of the eastern area, the thumb and fingers the more or less continuous ridges of the N.W., some less prolonged than others to the north-west, such as the Chor axis, which may be represented by the thumb, terminating on the southern margin near the Sutlej. The left hand placed opposite will represent the same features to the west of the Indus. We may further suppose the intervals or long basins between the fingers to be filled with sedimentary deposits, and the fingers then to be brought closer together, producing a crushing and crumpling of the strata. Conceive at the same time that an elevation or depression, first of one or more of the fingers, then of another or of the whole hand has taken place, and you are presented with very much what has gone on upon a grand scale over this vast area.

As these changes of level have not taken place along the whole range from east to west in an equal extent, but upon certain transverse or diagonal lines, undulations more or less great have been the result, and some formations have attained a higher position in some places than in others, producing, very early in the history of these mountains, a transverse system of drainage lines, leading through the long axial ridges.

The last efforts of these rising, sinking, and lateral crushing, and very slowly acting forces, are to be seen at the southern face of these mountains in the tertiary strata that make up the sub-Himalayan axis (Sivalik), a topographical feature which is most striking by reason of its persistence and uniformity for some 1,600 miles; for, although a similar and synchronal elevation of the Alps has taken place, the same regularity of orographical features has not been the result, most probably from the difference in the original outline of deposition in the latter area. From Assam on the east to the Punjab on the west, bending round and extending to Scinde, this fringing line of parallel ridges is found at the base of the Himalayas, sometimes higher sometimes wider, often forming elliptical valleys. Only in one part of the belt east of the Teetsa are they absent altogether, and for a distance of fifty miles the metamorphic rocks rise directly from the plains of India, a feature representing a great break—the correct interpretation of which will tell us very much of the past history of these mountains. These formations are of vast thickness, and in the Punjab, where they attain

* From the address by Col. Godwin Austen, president of the Geological section, British Association.

their greatest width and elevation between the Chenab and the Indus, cover an area of 13,000 square miles. The whole of this material has been derived from the adjacent Himalayas, representing many feet of the older and higher mountain ranges, and has travelled down valleys that had been excavated in pre-tertiary times.

This points to a slow subsidence of the whole southern side of the mountain mass, deposition generally keeping pace with it, broken off by recurring long intervals of re-elevation. Many long and instructive pages of its history are written on these rocks. These sub-Himalayan formations are fresh-water or torrential, showing that since nummulitic or eocene times the sea has never washed the base of the Himalayas. In fact, there is no evidence of this from the gorge where the Ganges leaves the mountains up to the base of the Garo Hills; pointing to an extension northward at that early age of the Arabian Sea, separated from the Bay of Bengal by peninsular India. From Assam to Scinde there probably once existed one continuous drainage line, a great river receiving its tributaries from the Himalayas, partly a land of lakes and marshes, the home of that wonderful mammalian and reptilian fauna which Cautley and Falconer were the first to bring to light. The Kashmir basin drained at the north-west end into the Kashingunga Valley to Mozufferabad, and that of Hundes and Ladak trended towards the same direction *viâ* Dras.

The southern boundary of this long alluvial plain was formed by the present peninsula of India, and probably of the extension of the Garo and Khasi Hills westward to the Rajmahal Hills. Depression has been considerable in the neighbourhood of Calcutta, nearly 500 ft. We know, probably, only a portion of the alluvial deposits. At 380 ft. beds of peat were passed through in boring, and the lowest beds contained fresh-water shells; the beds also were of such a gravelly nature as to indicate the neighbourhood of hills, now buried beneath the Ganges alluvium. This is precisely the appearance of the country above Calcutta on approaching the present valley of the Brahmaputra. The western termination of the Garo Hills sinks into these later alluvial deposits, and along the southern face of the range up to Sylhet, the waters of the marshes, during the rainy season, wash the nummulitic rocks like an inland sea, and point to the very recent depression of all this area. The isolated granite hill-tops jutting up out of the marshy country from Dhoobri to Gwalpara and on to Tezpur all testify to the same continuous depression here. It is exactly north of this that we find the Sivalik formations absent at the base of the Himalayas, and we have the evidence of exclusively marine conditions in pliocene times at the base of the Garo Hills.

We find also a large development of marine beds above the nummulitic limestone in the Jaintia country, passing up conformably into a great thickness of upper miocene sandstone of the Burrail range. In such sandstone, north of the Munipur valley, the only fossils found were marine forms. This gradual depression of the delta of the Ganges, the relative higher level of the water-parting and shifting of the Punjab rivers westward, appear to be only the last phase of that post-pliocene disturbance which broke up the Assam sub-Himalayan lucustrine system draining into the Arabian Sea. Zoological evidence is also in favour of this former connection of the now-separated waters of the Ganges and Indus basins, and the hill tracks of the Garo and Khasi Hills with peninsular India. The ground where the miocene rocks are absent is not where any denuding force from the north could have acted with any abnormal intensity. It lies under the hills, where no great tributary enters the plain, and might have removed the above formation. All the evidence is in favour of the axis line of depression in the Ganges delta between Rajmahal and the Garo Hills extending thus far, and that the miocene beds, once continuous, are here thus lost to sight beneath the more recent yet extensive gravels and conglomerates that here occur, and have partaken also of a last slight elevation of the mountain chain.

Great lateral rolls or waves of the stratified rocks occur at intervals all along the southern line of the chain, and apparently have a connection with the transverse drainage lines. Within the mountains in the old rock basins—and these are analogous to the valleys of the Alps—are pliocene and post-pliocene beds of great thickness, but of fresh-water origin; the remnants of which are to be seen in Kashmir and Scardo at intervals, along the valley of the Indus, and that large—now elevated—accumulation at the head of the Sutlej River in Hundes, first brought to notice by the labours of Captain (now General) R. Strachey. The remnants of these deposits in Kashmir and Scardo are found preserved in the more sheltered portions of the valley basins, untouched by the denuding action during the glacial period—the exponents presented to us of the enormous denudation that went on during the post-pliocene times, of which the glacial period formed a part.

The extent and displacement of the upper pliocene beds is in North Italy and here very similar. Often abutting horizontally against the mountains, they are in other places found tilted at a considerable angle on the margin of their original extension.

When we examine their contents, we find that the fauna of that time in Asia, as well as in Europe, was more African in character, and genera now confined to that continent were abundant far to the north. The sluggish rivers and lakes of Sivalik times in Asia and of the corresponding period in Europe were the home of the hippopotamus, crocodiles, and tortoises, of which the common crocodile, the gavial or long-snouted species, and an emys have survived the many geological changes, and still inhabit the rivers and low grounds of India to-day. The fresh-water shells are still the same now as then. Many species of antelope lived in the neighbouring plains and uplands; the elephant was there in the zenith of its existence, for no less than thirteen species have been found fossil in Northern India; but it is impossible in a short address to enumerate the richness of this fauna, and the extreme interest that surrounds it.

(To be continued.)

Electricity for Picnic Parties.—It is stated that the Cumberland Valley Railway Company has built an electric light car, which will be used to supply the electric light to picnic parties along the line.

Small-Wheeled Tricycles.—What can be done on small-wheeled bicycles has just been proved by the performance of Mr. Adams, who, riding a 44-inch "Facile" bicycle, started at midnight, Friday, Sept. 14, from a point one mile beyond Barnet, on the Hatfield-road, and rode through Hitchin, Biggleswade, Bedford, St. Neots, Cambridge, and Huntingdon, returning by the same road to Hitchin, and went on to Langford, which he reached at midnight on the Saturday, having covered a distance of 241½ miles in the 24 hours. The roads were in many places heavy with wet, and some time was lost on the way. Had it not been for these difficulties over 250 miles would certainly have been accomplished. Messrs. Larrette and Barrow, in accompanying Mr. Adams from Cambridge to St. Neots, rode the 18 miles in 25 minutes, a splendid piece of road-riding on a tricycle.

FLAMES.*

By W. Mattieu Williams.

WHAT are they? They are commonly described as merely heated or "incandescent" gas. In a note to Chapter VII. of "The Fuel of the Sun" I stated some reasons for questioning this definition and justifying "the conclusion that flame should be classed as another and distinct form of matter, in addition to those of the solid, liquid, and gaseous forms;" thus reverting to the four elements of the ancients—fire, air, earth, and water—their real meaning being that matter existed in one or other of the four conditions of fire, gas, solid, or liquid, their use of the word "element" being to express the idea that we now represent by "state."

I suggested further investigation of the difference between flame and incandescent gases, and Dr. W. Siemens has recently used the opportunities afforded by his regenerative glass furnaces for making such investigations. He finds that gases are not luminous at the temperature of molten steel (1,500° to 2,000° C.). At this high temperature the air emitted no light to a darkened room, showing that gases cannot be made red-hot or white-hot as solids may.

Further observations on the behaviour of flames themselves disproved Davy's theory that their luminosity is due to the incandescence of precipitated particles of carbon or other solids. My experiments showing the transparency of luminous flames (described in the above-quoted chapter) led me to the same conclusion, as such transparency of the white portion of the flame would be impossible if it were loaded with solid particles of carbon packed so closely together as to display continuous luminosity by their incandescence.

In the German *Annalen* of Chemistry and Physics, W. Hittorf now claims priority over Siemens in respect to demonstrating this non-luminosity of heated gases. He observed in 1879 that a layer of air surrounding electrodes of platinum, made white-hot by a battery of 1,600 cells, appeared perfectly dark, and that with iridium heated even up to fusion by a battery of 2,400 elements, the gas media whether nitrogen, hydrogen, or oxygen, remained perfectly dark, and that these gases, when thus heated, became good conductors of electricity, even when its potentiality or penetrating power was low.

It appears that Wedgwood in 1792 made similar furnace observations to those of Siemens, and, like him, concluded that the heated air therein was not luminous.

It appears, therefore, that flame is not white-hot gas, nor white-hot solid particles precipitated from the gas, but is matter in a fourth condition—*i.e.*, in the act of vigorous combination, or what I will venture to call *chemical vitality*.

Animal and vegetable activities depend upon the chemical combinations proceeding in organic structures, and if we may apply to the sum of these activities the designation of vegetable and animal life, I am justified in describing flames as an intense manifestation of inorganic or mineral life. There is really no innovation in this, but the opposite; it is a return to some very ancient conceptions.

In excavating at Suresnes, at the extremity of the Bois de Boulogne, the remains of a lake, or rather river, dwelling have been found. They consist, according to a correspondent of the *Rappel*, of piles and an enormous quantity and variety of bones, but at present no trace of iron or bronze has been discovered.

* From the *Gentleman's Magazine.*

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THE sketches of the mouth organs of the honey-bee given in Knowledge, October 5, show that the insect is provided with a licking, lapping, and sucking tongue of considerable length, while the wasp family have very much shorter tongues, and, except by biting a hole in tubular flowers, would not get at the nectar which the bee's tongue, like the long proboscis of the butterfly, makes it easy to reach.

Various accounts are given in different books of the structure of the bee's tongue, and some of them are evidently founded upon imperfect observation. Such objects are by no means easy to see properly, and as many readers of Knowledge may be glad of a little help in making a microscopical examination, we may suggest how they had better proceed. First catch a bee, as directed in the last paper, and watch it feeding in the test-tube. As stated, the tongue makes a sweeping, backhanded motion. It is like putting the hand, knuckles all down, on the table, and then drawing it forwards, raising it a little, and finishing the sweeping motion at the finger-tips. To understand the meaning of these motions, cut off the head of a bee, stretch the tongue out with a needle stuck in a little wooden handle, and then with a droplet of gum fix the head on to a glass slide. These arrangements and ordinary dissections are easily made under a hand-magnifier, the object being placed on a piece of glass. Mr. Baker (High Holborn) sells hand-magnifiers for the pocket, which can also be attached to little brass stands to hold them at any height required, and they are good substitutes for a dissecting microscope. Mr. Browning also makes a cheap botanical dissecting microscope, which, with a larger piece of glass for a stage, answers for general purposes.

Having prepared a bee's head as described, look at it with an inch power and reflected light. This enables it to be seen much as is represented in Fig. 1 in the last article, but the tip will, if the specimen is quite fresh and uninjured, look a little rounder. The mandibles, D D, are depressed in the figure to show the other parts better. After carefully looking at the bee's head in the way mentioned, take another bee and carefully remove all the mouth organs from the head, operating with needles, while the object, or subject, is immersed in a drop or two of glycerine. This fluid prevents any shrinking of the parts, and gradually sinks in, making them transparent. As soon as the mouth organs have been well cleaned from any dirt or stray particles, place them in the little cavity of a "hollow glass slide" which opticians sell.

This is an ordinary slide of thin plate-glass with a hollow ground out in the middle, and then polished. It forms a convenient cell in which to examine objects that must not be squeezed flat. In the case of the bee's mouth organs it is well to remove the mandibles, as they are in the way of seeing other parts. The hollow slide should be filled with glycerine diluted with a little water, and the tongue, labial palpi, and maxillæ neatly spread out. Then put on a glass cover. This most likely squeezes some of the fluid out, although the precaution has been taken of putting a drop of glycerine upon it before placing it over the object. If an inconveniently large air bubble is formed, slide the cover a little off the hollow, and put in a little more water or glycerine with a glass tube drawn out like a dropping tube, but with a rather finer point than usual. When

immersed in glycerine the tongue, with its appendages, becomes a singularly beautiful object, with dark ground illumination. A power of $1\frac{1}{2}$ in. is handy for a preliminary view, after which a half-inch will exhibit most of the important details. The hairs are exquisitely arranged in a series of whorls, and become very brush-like towards the tip. All through the tongue there runs a tubular hollow, and at the tip an opening may be discovered as shown in the arched part of Fig. 3 (Oct. 5). I made a mistake in describing this as *underside* uppermost. It is exactly the opposite. The opening into the tube is on the upper side, which the reader will please correct in p. 217. This sketch was made from a preparation in Canada balsam, which permits the use of much higher powers than can be employed when an object is in a cell with fluid, but it has the important disadvantage of pressing together parts that ought to be seen in their natural positions. The tip of the tongue is damaged by this squeezing. As seen in the glycerine it is not at all flat, but somewhat puffed out, and with a hollow like a spoon. Seen sideways the spoon shape is very plain. It is provided with peculiar short, sharp, curved spines. I imagine from an examination with high powers that at the base these spines may be provided with nerve filaments, and that they may be sense-organ appendages, like cat's whiskers. After the tongue has been kept a few days soaking in glycerine, its transparency is increased, and the tube which runs down it is seen to be connected at the base with a bladder-like pharynx. The act of extending the tongue causes the whorls of hairs to stand out a little, and this makes them very effective for the sweeping use made of them.

The maxillæ, as seen with the half-inch objective, are not only hairy—which the knife-like maxillæ of biting insects are not—but liberally provided with respiratory tracheal tubes running across them. External organs freely supplied with these tubes are usually adapted to collect some information; that is, receive and transmit some impressions. In the bee, the maxillæ are tongue-helpers, and we may be sure that a supply of nerve-power secures the harmonious co-operation of the several parts of this complicated feeding apparatus. As it is not convenient for Knowledge to give much space in one number to a single subject, further elucidation of the bee's mouth organ must wait for the next paper.

KRAO.

At the recent meeting of the British Association, Mr. J. Park Harrison introduced the subject of Krao, the so-called "missing link." He said that the idea that the hairy child lately exhibited at the Westminster Aquarium possessed ape-like peculiarities, which she had inherited from wild parents in some remote forest in Laos, appeared to be so widely entertained that he thought it well to bring the subject before the department. He quoted statements that had been made in advertisements, and in a circular issued at the Aquarium, and called attention to the guarded language of some of the daily papers, and he then said it was unfortunate that an account by Dr. Garson, which had appeared in the *British Medical Journal*, had not obtained a wider circulation. That account showed that there was nothing abnormal in Krao except hairiness, and since then a letter had been published from a resident in Siam which stated that her parents were Siamese, and were then living. Neither possessed any special peculiarities, nor did their other children. Siamese was Krao's native language, but she had picked up a little Laos. The joints of her arms and fingers were flexible, but not more so than those of other Siamese. Her power of grasping things with the toes was also possessed more or less by all the Siamese, who are a barefooted people. Her parents were in the habit of showing her, and they sold her for £60—double the value of an ordinary child. The first letter of her name expressed whiskers. She was an intelligent Siamese child, with no peculiarity beyond hairiness, and she possessed rather a pathological than an anthropological interest.

Dr. Garson said that the child was a well-marked example of the yellow-coloured races found inhabiting the eastern parts of India. The cheeks were normal, there was no enlargement of the space between the gums and the cheeks, and the fulness of the cheeks was entirely due to their thickness. There were no double teeth; the hands and feet exhibited mobility, the feet not having been deformed by boots. The direction in which hair grew could be studied from this child on account of the quantity. On the fore-arms the hair was directed outwards and upwards; on the upper arms it was outwards and downwards. Such cases occurred in various races and in different parts of the world. In many the development had been greater than in this child. There were no ape-like characters present, nor any that would indicate specific difference of any kind. As to the so-called rudimentary tail, there was no abnormality to be observed in that region. Cases of reported development of tail were extremely doubtful. In some cases slight abnormalities did occur, but could not be regarded as tail developments. Every one had normally a homologue of a tail, but it had only in one or two cases been found to be enlarged in size. The explanation as to these abnormal developments of hair which seemed most reasonable was the atavistic theory. If we were able to trace back man to a primitive condition we should probably find that he was covered with hair The follicles in which the hair grew had not disappeared in ourselves, and an abnormal growth was simply the reappearance of an old condition which was normal in the primitive race of man.

Dr. Struthers, of Aberdeen, described Krao's case as a special case of development of the hair which was normally rudimentary on the human body. He had once in Aberdeen had to examine the case of a body reported to have a tail, but he found that it was simply a case of misdirection of the natural bones, and so the tail case broke down. The anthropologists were often jokingly asked when they were going to find a man with a tail. It should be remembered that even the higher apes had no tail, and therefore the question of tail or no tail was of no importance. To discuss the missing link was to tread on dangerous ground. Hair would never settle the question. The great point was the brain. The missing link was not a link, but a chain. The brain was one link, and the other was erect posture. If we could conceive a monkey having somehow got one day an abnormally superior brain, it would not remain up a tree. Then his limbs would commence to adapt themselves to their new conditions. Given the larger brain and the larger intelligence, the other development would follow in the course of time. The missing link, in one of the most painful senses, could be seen any day in the idiot ward of an asylum.

Mr. Hyde Clarke said he was one of the Council of Science of the Westminster Aquarium, but they had not been asked to see Krao. He classed the "missing link" with the tattooed Greek sailor and the whale that turned out to be a porpoise.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

VI.—THE CAVE-DWELLER.

Actinia troglodytes (Johnston). *Scolanthus sphæroïdes* (Holdsworth.)

BY the early writers this anemone was called *viduata* (widowed). Dr. Johnston adopted, after Mr. Price, the more distinctive term *troglodytes*, cave-dweller (from τρωγλοδύτης, one who creeps into holes). Though abundant in many localities, and widely distributed all round our shores, it is not easily found by unpractised collectors, on account of its retiring habits. Its favourite custom is to hide itself in holes and crevices of rocks, in shallow tidal pools, and on the floors of caves. When scores of them are expanding their flowers in profusion at the bottom of the bright water, they may easily be overlooked, since their mottled disks and barred tentacles resemble the sand and gravel in the pools where they live. They shrink on the slightest alarm, and hide themselves in the sand or mud, protruding only their tentacles perpendicularly, and sometimes barely the tips of these organs can be seen. When sand or mud is not available, their concealment is frequently secured by suckers on the column, to which fragments of shells and quantities of gravel become firmly attached, and even when placed in a tank they frequently retain these foreign bodies with great obstinacy for a considerable period.

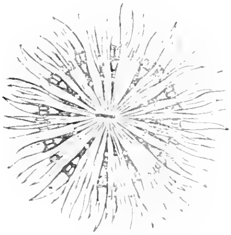


Fig. 1.—Disk, with B mark on Tentacles.

Fig. 1. *The Disk, &c.*—The chief characteristic feature of troglodytes is the black mark at the foot of each tentacle, which is nearly always relieved by two white curved spots, forming together a strong resemblance to the Roman capital B. The tentacles are numerous, in fine specimens between two and three hundred; they are set in four or five rows, and, as usual, the largest are innermost.

There is no species of British anemones that varies so widely in colour of disk and tentacles. The general pattern of the disk is well described as resembling the pencilled pattern of a snipe's feather. The bright orange, grey, and blue black varieties are the handsomest, and there are fifteen or sixteen others derived from the admixture of these colours.

The marking of the disk itself, apart from the tentacle, is pretty constant. Each radius is light grey from the B marking on the tentacle to half way to the mouth; then there is a bright white spot, as shown in the figure, followed by a thin line of yellow, or drab edged with black, which is continued to the lip. The mouth is usually whitish.

Generally there is no difficulty in determining this species. The B mark is the most certain distinction, and in the few instances where this is not discernible, the firm texture of the column and base, Mr. Holdsworth points out, is "a fair mark." Troglodytes is not so easily injured as most species are, and his adhesive power is comparatively weak.

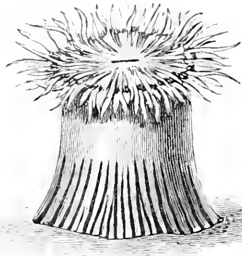


Fig. 2.

Fig. 2. *The Column.*—The general colour is green, with an admixture of brown, producing various shades of olive, and sometimes dark brown columns are met with. The lower half is marked with pale stripes, which are broader towards the base. Above these stripes the column is smooth, and the suckers are there marked by pale spots.

In large specimens the column is from 2 inches to 4 inches in height, and from 1 inch to $1\frac{1}{2}$ inches in diameter, while the disk has fully 2 inches in breadth of bloom. Morecambe Bay and Torquay give specimens with orange and rose-red tentacles and disks; while from Boulogne they are obtained with rich full lake and light lilac colours displayed in their flower.

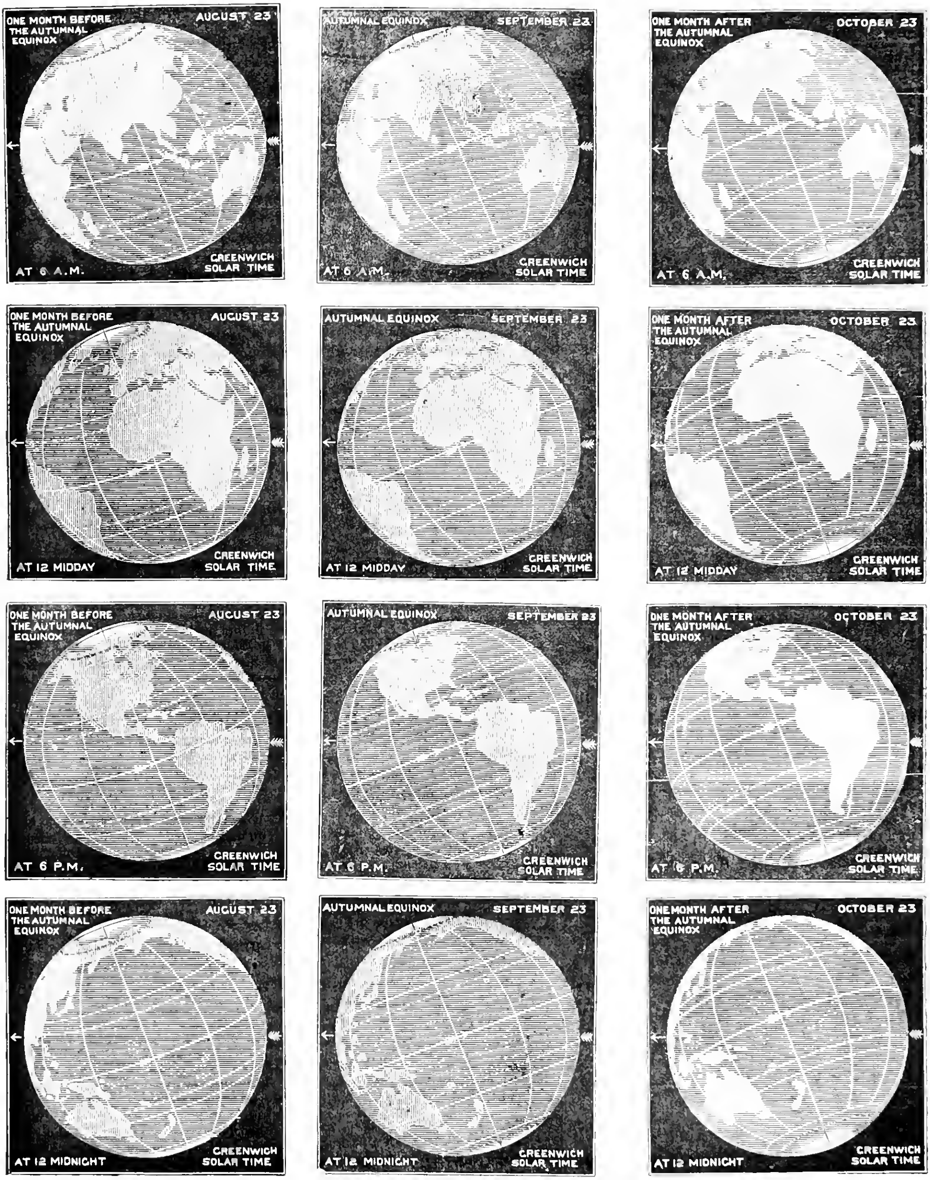
Mr. Holdsworth met with examples of this species in deep sands or mud at Seaford, near Beachy Head, so peculiar is their habits, that for weeks in succession they kept retracted both disk and base so as thereby to assume the form of a flat bead or an onion, and evinced no disposition to attach themselves by their bases after the manner of their kind.

From this circumstance he named them *spheroïdes*, believing them to be a distinct species, living entirely free from attachment; but he has since seen reason to modify his views.

On some occasions, in the glass tank or vase, examples of this peculiar type will attach themselves by the suckers on the upper part of the column, and then they appear in an almost inverted position, with their base uppermost, where their disk ought to be. Specimens of this class are called by different writers vagabond, homeless, restless, and, besides receiving other hard names, they are described in this stage of their existence as "sowing their wild oats," after which period they settle down, lead a quiet life, and become respectable. They are then a credit and an ornament to any aquarium, and perhaps all the more cherished for being reformed characters. This roving free habit marks especially the mud-dwelling class of troglodytes.

The disposition to be at all times less firmly attached by the base than other species, and the habit for lengthened periods of living quite detached, particularly distinguishes *Troglodytes* as constituting an intermediate link between the permanently free and the permanently attached forms.

One Month before Autumnal Equinox. At the Autumnal Equinox. One Month after Autumnal Equinox.



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week the Sun Views for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight, Greenwich solar time, a month after the autumnal equinox. For comparison, the Sun Views for August and September are repeated.

FISH AND PHOSPHORUS.

By W. Mattieu Williams.

A CURIOUS notion concerning fish diet is widely prevalent. It is supposed to supply special brain food. If this were true the Dogger Bank fishermen, who feed on cod-fish, should be intellectual giants. I sailed for two months in a schooner, the skipper, the mate, and half of the crew of which had for many years eaten cod-fish at every meal. They were by no means remarkable for cerebral activity, nor are the rest of their class.

The popular fallacy seems based on a series of other fallacies. First, that there is something very spiritual in phosphorus; second, that phosphorus is a special and exclusive constituent of the brain; and third, that fish contains more phosphorus than other food materials.

The first is mere imaginative nonsense. The second is a half-truth. Phosphorus is a constituent of cerebral and other nervous matter, but it is also a constituent of bone, which contains about eleven per cent. of phosphorus, while brain matter contains less than one per cent.

The third fallacy seems to have originated in that very common source of error—viz., dependence on mere words. Fishes are remarkably phosphorescent—*ergo*, says the word-slave, they must abound in phosphorus.

The fact is that the chemical element named phosphorus has nothing whatever to do with the phosphorescence of fishes, nor with that of the multitude of other phosphorescent animals. The glow-worms (of which there are many species in England alone) and the numerous insects included under the general name of fire-flies are brilliantly phosphorescent without the aid of phosphorus. The minute jelly-like creatures that at certain times render the crest of every breaking wave a blaze of light, and mark the course of porpoises and bonettas with pale rocket-like trails, are animals in whose composition phosphorus is especially lacking.

The true connection that exists between the luminosity of phosphorus and that of organic phosphorescence is that both are dependent on slow or languid chemical combination, while vivid combustion is a manifestation of intense or vigorous chemical combination. Ordinary combustion is a vigorous combination of something with oxygen; the phosphorescence of phosphorus is due to a slow oxidation of this element, and it is probable that the other cases of phosphorescence are due to the slow oxidation of something else.

B. Radziszewski has recently investigated this subject, and concludes that the phosphorescence of organic bodies is produced by the action of active oxygen in alkaline solution. (Ozone is another name for active oxygen.) He describes two kinds of organic phosphorescent matter, the first of which contains hydrocarbons, and the second aldehydes, or yields aldehydes when treated with alkalies.

According to this, all phosphorescence is a result of slow combustion, like that which produces animal heat, or the heating of a damp haystack or other heap of vegetable matter and water.

As heat and light are both due to internal activities of matter, differing only in a manner analogous to the difference of motions of the air produced by the difference of the vocalisation of Santley and Patti, the mystery of Will-o'-the-Wisp, of oceanic phosphorescence, glow-worm light, &c., is no greater than that of the warmth of our own bodies.

The anomaly of phosphorescent light is that it is accompanied with no sensible elevation of temperature, while ordinary combustion, when it rises to the pitch of effecting luminosity, is accompanied with intense heat.

There must be an essential difference between the waves of white light emitted by incandescent platinum or white-hot carbon, and those from the glow-worm. I am not aware that mathematicians have satisfactorily fitted the undulatory theory of light to the explanation of these differences.—*Gentleman's Magazine.*

Persons who fancy that wetting coal increases the heat in the furnace may be interested to know that a series of tests was made recently at Bochum, Germany, to determine the values of wet and dry bituminous coal in making steam. According to the American *Mechanical Engineer*, washed slack, holding 18 per cent. of water and 9·9 per cent. of ash, evaporated 5·7 lb. of water per pound of fuel; while the same coal, with only 3 per cent. of water, made from 8 to 8·5 lb. of steam. Making due allowance for moisture by reducing to a standard of like quantities of coal from moisture, there is found to be a direct loss, by using wet coal, of 14 per cent.

Organic Compounds in the Sun.—The third volume of the Royal Engineers' Institute Occasional Papers, recently published, contains a very interesting communication from Captain Abney, upon a new method of spectroscopic analysis as applied to the investigation of solar physics. Captain Abney's and Colonel Festing's combined investigations referred to that part of the spectrum lying beyond the extreme visible limit at the red end, the energy of which can be made apparent under certain conditions, and the dark lines beyond this limit may be photographed and thus accurately mapped out. As an illustration of the practicability of this, Captain Abney described a very beautiful experiment suggested by the permeability of ebonite to the energy of certain rays, as shown by experiments with the photophone. He arranged an arc light so that the image of the carbon points and of the arc were thrown on the focussing screen of the camera, and he then interposed between the light and the plate, which was sensitive to dark radiation, a screen of ebonite. The success of this interesting experiment proved that ebonite is transparent to the dark rays beyond the red end of the spectrum. Experiment showed that in this region very few metals have any lines, those fusing at very low temperatures, such as sodium, potassium, and calcium alone giving indications, and this suggested that the dark lines seen must be due to other and probably compound bodies. Commencing with water, Captain Abney and Colonel Festing examined the spectra of a large number of compounds, some of them highly complicated, and after their experiments had been completed, they compared the spectra they had obtained with the solar spectrum. The coincidence observed by these comparisons led to the "inevitable conclusion that we must have some derivation of benzine and ethyl present either in our atmosphere or in the sun." Solar spectra taken at different times of the day proved the former supposition to be untenable, although Captain Abney states that recent experiments lead him to believe that such derivations exist in space. These investigations largely confirm, and are confirmed by, those of Dr. Huggins, on the composition of cometary matter. Dr. Huggins has shown by the spectrum the existence of hydrocarbons not only in comets, but also in nebulous matter, and his results accord with those of Captain Abney and Colonel Festing, whence Captain Abney deduces "that there is no doubt whatever in my mind that as spectroscopic science advances, so we shall be able to place more and more compounds in the stars, in the sun, and in cometary matter."—*Engineering.*

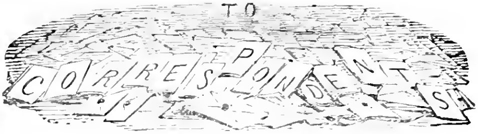
LOCUSTS.

THE districts of Matheran and Mahableshwar, in the Bombay Presidency, according to the *Colonies and India*, have been suffering from an invasion of locusts, huge swarms of which have settled on the trees, which appear to be covered with red foliage and clusters of red flowers during the occupation, but when abandoned are nothing but bundles of bare twigs. While the locusts are on the wing, it is difficult to make any impression on them, although an Italian landowner, resident in Cyprus, has destroyed vast numbers by placing in their path, soon after they are hatched and still unprovided with wings, pits so prepared that, after tumbling in, it was impossible for them to get out. This, however, is only feasible during the wingless stage, when the young locusts march across the country in great columns, more than a mile in breadth.

But the most radical treatment is that of destroying the eggs, which, fortunately, are deposited, not singly, but in masses in one place, generally on an uncultivated hillside. The female inserts the eggs by means of a sword-like appendage, and sheds a glutinous matter for their protection; and, as traces of this may be seen glistening on the surface of the soil, it affords an easy clue for the searcher to discover their whereabouts. In Cyprus rewards have been offered and taxes imposed with a view to stimulating the peasantry to destroying the eggs, 62 tons of which were brought in during 1868, representing 50,000,000,000 locusts, the result being that the pest disappeared for several years.

Enormous as is the destruction caused by the locust, there is one advantage about it, viz, that it is edible—in Arabia men and horses using it regularly as an article of diet. By some of the natives they are eaten with oil after being stripped of their legs and wings, but Lady Anne Blunt, in her travels, was in the habit of boiling them and dipping them in salt. Their flavour is described as savouring of a vegetable, not unlike the taste of green wheat.

Mr. T. R. Cuthbert E. Peek read a paper at the recent meeting of the British Association, on the hot springs of Iceland and New Zealand, with notes on Maori customs. The author had recently visited the hot springs of Iceland and New Zealand. Several most important differences were noticed in their composition. In the case of the hot mud wells of Iceland there is so much copper suspended in the mud that several companies have been started to work them commercially; while the mud springs of New Zealand are so full of infusoria that in times of famine the natives manage to sustain life on a diet chiefly consisting of mud. Some of the New Zealand springs contain a very large percentage of mineral, and the analysis of one of the most powerful was given. The hot springs of New Zealand appear to extend from Mount Tongariro to White Island. On April 25 Tongariro was observed to be giving out more smoke than it had given out since 1870, when a considerable eruption took place. The two most remarkable objects in connection with the New Zealand geysers are the pink and white terraces. These consist of regular steps, each of which forms a small basin full of the clearest water. In the case of the white terrace the water has a beautiful sky-blue appearance, while at the pink terrace the whole is tinged with a delicate salmon colour. The upper basin in each case is about eighty feet above the level of Lake Rotomahana. The whole country round is covered with hot springs and mud wells, and the greatest caution is required to avoid an accident, which would probably be fatal.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE GREEN SUN IN INDIA.

Indian Ocean, Lat. 9.25 N., Long. 65.16 E., *Sept.* 10, 1883.

[961]—I write to you an account of the very peculiar colour of the sun this morning, and should be glad if you could advance any theory for such an occurrence. The sun rose about six o'clock this morning, and upon appearing upon the horizon it was a bright emerald green, and it retained the colour until it was some distance in the heavens, although as it rose it gradually got a lighter shade. There were very few clouds about, and those were of a light, fleecy nature. There was another curious effect. The decks were being washed, and the rays thrown upon the rails and hurricane-deck were reflected of a pale emerald green. Last night was a fine sunset—some dark clouds lit up with crimson and bright orange shades. The wind is light, and the sea quite calm. We have had no rain since we left England—Aug. 16. We have two old sea captains aboard, and they say never in their experience did they witness such a phenomena.

6.30 p.m., *Sept.* 10.

Since writing this morning I have watched the sun set, and as it approached the horizon it assumed the green shade, which intensified the nearer it got to the horizon. We could not see it dip, as some clouds at the moment obscured it. The light thrown upon the back of the clouds was pale golden. We have lost the moist atmosphere of the 8th and 9th September, when we were in the last of the monsoon, and knives and keys were rusted in the pocket, and a pair of scissors left in a work-basket in the cabin would be coated with rust in twenty-four hours. Sept. 11.—The sun rose and set to-day of the same green colour. Sept. 12—We had a slight shower at 5 a.m. of only a few minutes' duration. The sun again rose green in the W. and S.E. The sky was of a deep blue, with some white opaque clouds that stood out in bold relief. In the east there were some light fleecy clouds, and in the S.W. some dark heavy ones that were discharging rain, but they were a long way from us. We are making about 5° of longitude east per day, and ½° of latitude. I shall observe the sun to-night and to-morrow morning, and post this at Colombo to-morrow. Last night the sun again set green. Sept. 13, 6 a.m.—We are just entering Colombo, and the sun is rising the normal colour. One of the quartermasters informs me that last evening the moon, when approaching the horizon, assumed the same green colour. No one here on board has any theory to account for it. H. M. J.

S.S. *Mirzapore.*

[We shall consider this subject specially next week, when more evidence will be collected. R. P.]

GREAT SUN-SPOTS AND SUN BLUE.

[962]—On the afternoon of Thursday, October 11, a good deal of foggy light cloud was drifting across the sun's face, making it possible to take naked-eye views of the luminary. I was surprised to see distinctly two very large spots, and (I think) to glimpse a third. I have unusually good sight, and have frequently seen single naked-eye spots during the past two years, but have never seen two at once before, nor do I know if the observation has often been made. I took an opportunity some hours later of examining the sun with a small hand telescope, and was well rewarded for my

pains, as it presented a beautiful view, being covered with groups of spots all over the zone in which they appear.

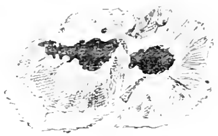
I see by the daily papers that an unusual "blueness" was observed on the orb, on the same day, [?] at Panama and Colombo. It seems plausible to consider that our great "variable star" has reached a minimum of light and a maximum of disturbed surface.

T. P. B., Lieut. R.A., F.R.A.S.

GREAT SUN-SPOTS.

[963]—I enclose a rough drawing of the sun-spot described by "Excelsior" [943], made with a terrestrial telescope of 2¾-in. aperture, on Sept. 16. It was visible to the naked eye as a black spot to the right of, and below, the sun's centre. As far as I could judge (being unprovided with means for exact measurement), it was about 1¼ in. or 1½ in. in length. There were no "bridges" visible, but there were signs of their formation in the left-hand spot. There were bright faculæ to the right of the spot.

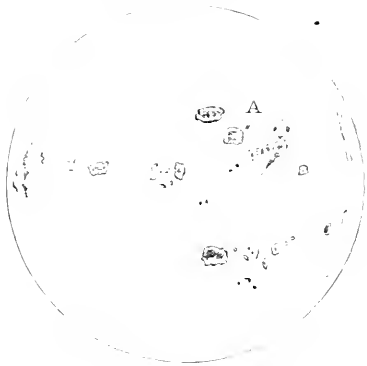
Vignoles.



P.S.—How is it that the left-hand is the eastern limb of the sun? I always thought the sun rotated from W. to E., in which case would not the left hand be west? Could you kindly explain the mystery?

[When a man faces you would you not say that his right limbs were to the left as you view him?—R. P.]

[964]—The most astonishing change has taken place on the sun's surface since Saturday last. On that day the highest power at my disposal could reveal but seventeen spots of size enough to exhibit detail. The sun's disc was hidden by clouds and fog till this morning, when, on turning my telescope (3-in. Dollond) on the sun, I found the disc was covered with spots from limb to limb. I could get but transitory glimpses owing to the clouds, but I managed to obtain rough sketches, of which I send you copies, as



Appearance of Sun, Oct. 10, 1883 (Power, 40).

I think the complex construction of the group marked A in the sketch might interest you. In this spot, which had but one penumbra, I counted no less than twenty-three nuclei. I noticed that the "granules" were exceptionally well brought out. Is this the effect of fog? The time was too short and the sun's image too faint to measure the spots by projection, so the dimensions are guess-work. However, I think I am justified in saying that there were three or more spots of 2′ or over in diameter. The most northerly of the three huge spots has a very curiously spiral appearance. It looks like two whirlpools, whirling opposite ways and joined together. My sketch of it was unfinished, owing to clouds, but I hope to see it to-morrow.

Group A.—Wednesday, Oct. 10, 1883. 3.30 p.m.
(Telescope, 3-in. aperture; Power, 80).

What is the position of the solar axis as seen from the earth at the different seasons of the year? Not knowing this, I cannot even approximately record their position from day to day. Then what means are there of ascertaining if the equator of one's scale coincides more or less with the plane of the ecliptic? This, of course, changes the aspect of the spots as seen morning and evening.

Vignoles.

[To these questions a reply shortly, with suitable illustrations.—R. P.]

MOON'S SURFACE.

[965]—Some time ago, in Vol. I., I think, several methods were given in Knowledge for producing a surface similar to that of the moon. In the course of my work to-day, I came across a very pretty illustration. By trade I am an electro-plater, and I had been "throwing down" some old silver solution, and had got my silver chloride precipitate settled at the bottom. After washing and filtering, I had put it, in a pasty state, over a good strong gas-stove. The temperature was high, and as the water began to boil it all spirted up through the paste, and some splendid volcanoes were produced. With the steam that issued out of them, the more liquid paste also rose, and flowing out of the mouths of the tiny craters, and gradually drying, made those ridges or ranges of mountains which one sees in the moon. In one place there was a most beautiful "Copernicus," which was formed thus:—The steam out of one crater kept on blowing thick bubbles, which, bursting, formed a ridge all round the interior of the crater. In another place I had my "Tycho." The stuff gradually drying, cracked in several places. I poked a thin stick down one of the craters, and when I pulled it up the more liquid stuff from below came up also, and filled all the fissures, making the thing look very real.

I should think that the same thing done with plaster would be very useful, and would be more like the real thing than throwing sand on to it.

Silversmith.

SMALL WHEELS FOR TRICYCLES.

[966]—Some of my correspondents tell me that they should be glad to try tricycles with smaller wheels, but makers tell them it is impossible to make front-steerers with vertical pedalling, so as to keep the heels of the riders clear of the axles, without putting the riders so far forward that a considerable weight shall be thrown on to the front steering wheel.

This is a mistake. Messrs. Singers have recently made to my instructions an "Apollo Sociable" with 40-in. wheels. With the saddles almost over the pedals the machine is so well balanced that the front wheel can be easily lifted by a sharp pressure of one foot by a single rider when both are seated, and yet the heels of the riders are clear of the axles by about 1½ in.

John Browning, Chairman of the London Tricycle Club.

TRICYCLE WHEELS.

[967]—A few days ago I had Knowledge sent to me, and I much regret I have not seen it before. I can only say in future I shall read it regularly. As I am writing a treatise on the theoretical and practical construction of the tricycle, which I hope to be able to publish before the next spring exhibition, I am much interested in the letters of "Sigma" and others regarding the size of the

wheels, and I hope a few remarks of mine may assist tricyclists in forming correct conclusions. The reason why opinions so greatly differ is that the height of the rider, the weight of the machine, the gradient and surface of the road, and the comfort of the position are not by different persons equally considered and allowed for. I cannot give in a letter the mathematical proofs for my deductions, but I will mention them as results only. It is a fact that given the man and a perfectly level road, a machine can be built to fit him properly, that is to say, on which he can exercise the greatest comfort in position, the best average speed suitable to his strength, and the best adjustment regarding the transfer of his power to the machine, and with evenly-geared wheels. This machine will be best for cycling on level roads with ordinary obstructions. The dimensions of the wheels work out as follows.—For a man 6 ft. high, $48\frac{3}{4}$ in.; 5 ft. 10 in., $47\frac{1}{2}$ in.; 5 ft. 8 in., $45\frac{3}{4}$ in.; 5 ft. 6 in., 44 in. Starting with this "best machine," it is for cyclists to alter the proportions to suit their various requirements. For racing on a level track the wheel can be greatly reduced with much advantage from the saving of weight and gearing-up. For rough level roads the reduction must be much less than for racing-path—in fact, 2 in. less will be ample; and for hilly roads a wheel 2 in. larger than the normal size will be more suitable, the gearing down or up being a matter of strength.

The reasons that should guide a person in this matter are simple. A big and little wheel run (for our purpose) equally freely on a level surface without impediments. On a track, therefore, a machine cannot in reason be too light with small wheels geared-up to the rider's power. Now, it is known that the measure of propulsion in a tricycle is the amount of weight in suspense in front of the axles (that is to say, disregarding muscular propulsion, which is only supplementary). When, therefore, a rider arrives at a hill, the size of the wheel regulates the distance his weight is thrown behind the axle, and as whatever weight is behind the axle has to be compensated for by the propulsive power before any propulsion is given to the machine, it necessarily follows that small wheels are very much worse than large ones for hill climbing, as the rider will have to uselessly expend exactly as much force to counterbalance the amount of weight thrown behind the axle, or else bend himself double. The larger the wheel, therefore, the less waste on this account, so for rough roads and hills it is better to have large wheels at the expense of extra weight, which also gives increased strength, &c., for the extra strains and jolts, the power being the same, owing to the gearing-down. This principle being known, cyclists can then choose small or large wheels according to the country they travel in. I hope in my little work to explain the *pros* and *cons* that should guide in forming an opinion as to the dimensions most suitable for special requirements. I would generally recommend a man of ordinary power, with fairly good roads and content with from 7 to $8\frac{1}{2}$ miles an hour, weighing a fair average weight in accordance with his height, to ride a machine evenly geared, with wheels as in my table. Then if strong, and preferring a faster pace, use larger or smaller wheels and gear up or down according to the nature of the country generally ridden. For rough roads err rather on the side of strength, as although a light machine may be pleasant, still a feeling of safety against a probable collapse is to be considered, and I feel sure, for ordinary riders, a machine built with evenly-geared wheels will afford the greatest pleasure for all-round work, and give most satisfaction. I may mention that the swing frame enables smaller wheels to be used for hill-work; and as next season the patent will be open to other makers, if they wish to adopt it, I have no doubt smaller wheels will be used in future, as the objection mentioned by me before will be overcome by the rider's weight swinging in front of the axle in accordance with the gradient. F. WARNER JONES.

LETTERS RECEIVED AND SHORT ANSWERS.

OMEGA. Thanks for corrections. But as to your remarks about whist, tricycles, &c., I would ask you to remember that there are other readers besides yourself, who not only like these papers but complain when (as recently) such articles do not appear regularly. Your way of telling the editor what the generality of the readers want is *tant soi peu* suggestive of coolness.—ONE WHO WOULD LIKE TO BE STRONG. Have sent your letter on. The author of these articles says he cannot think any one can get harm from running exercise begun and continued carefully as he suggested. A pigeon-breasted youth might certainly hurt himself by starting to run a mile or even much less at the first effort. But a steady daily run, begun at short distances and never pushed to distress, is not going to hurt him, but rather to do him much good in the long run, even if he should never come to a long run.—J. K. MURRAY. Certainly you are right. If you put the point of any object against a glass, the distance between that point and its reflection will be twice the thickness of the glass, *not* once, as stated in "Reason Why."—E. D. GIRDLESTONE. You insinuate that being editor I burke your reasoning, and convert my editorial chair into a "coward's castle." I can only follow the course which commends itself to me as best, and it did not seem to me best to insert your very long argument in defence of Jack Ketch, in the course of which you made out that the average hangman is rather better than military and naval men and might be (as you said at the close) a long way better than the average editor. If it was very ill-mannered, after that, to call your letter "illogical," or your comparison between our fighting men and hangmen "sheer nonsense," I am sorry; but emphatically, my dear sir, You began it, as boys say. You say you have learned to be pachydermatous: verily, it is as well; you need to be. Your picture of Jack Ketch as "the ingenious mechanic inventing improvements in the art of suspending and dropping weights and then putting his scheme in practice," or as "the poorly paid father of a large family who for his children's sake would accept work otherwise most distasteful to him," may seem to you truthful. I hereby lay it before readers of KNOWLEDGE as the result of your thought over this subject; merely remarking that the art of suspending and dropping weights may be put in practice in other ways than by hanging, while I should think a decent man with a large family would rather hang *himself* than degrade his children by taking the hangman's office. In saying that everyone knows the real nature of candidates for this office, I used a form of words which is I admit (will that content you?) not strictly correct. One says in the same sort of way, Everyone knows the earth is a globe, though of course strictly speaking this is not true; for there are a few who think the earth flat, and I see now there is one Lieut. Middleton who has got beyond that and thinks her surface rather hollow. As to your closing remarks, I really have never thought whether I am "far your superior in age and experience, in talent and acquirements." If among my correspondents a Methuselah, with the experience of a Solomon, the talent of a Galileo, and the acquirements of a Whewell, were to advocate a view which seemed to me incorrect, I should say so, and try to maintain the position I deemed just. For yourself, if in a half-column letter you can maintain your view about the hangman, keeping to the question, and setting down naught in malice about "the services" or my poor services as editor here, you shall have the space. But what is mistaken for editorial cowardice is very often editorial kindness. I get some letters which it would be sheer cruelty to publish.—T. HARRIS. Too bad of Airy to call them lunatics, was it not? Yet not suitable subject for a lecture.—FATIMA. Quite with you on that question. —W. HARRIS. The sun rises at Hayward's Heath on November 1st about 23 degrees south of east, or very nearly East-South-East. COSMOS. Your question, "What is the rate of variation in the curvature of an ellipse?" is not clear.—B. D. Thanks; but your suggestion earlier made by another.—E. K. H. A. Thanks for amusing cutting from *Tit-bits*. It *is* news that the sun is ever at the zenith at our antipodes. The use of technical words probably made the answer as good (or as worthless) as if it had been correct.—H. HANSKY. No room at present for Lithography.—DESPONDENT. I know of no better way to overcome extreme depression than by getting something to occupy your mind and body too. Try some long-lasting occupation for the Blue Devil as Michael Scott did for his Black One. He set him to make a rope of sand: you might try to prove the earth a globe to the satisfaction of Mr. John Hampden: the task will be as endless, but it will serve the suggested purpose. —T. R. HUTTON. That is probably the right view of meteoric and cometic matter; only there is not enough now left in our system to be visible from any point of view as nebulous matter round sun.—G. G. CHISHOLM. Article in type, but great pressure of matter may prevent its early appearance.—C. H. WREN. A new series of such notes will shortly begin.—ARNOLD REED. Please ask questions separately.—W. GRANDY. Thanks for suggestion.—SILVERSMITH. Thanks. Letter has already appeared.—KERRY RIX. Ditto.—W. GILDART. Do not know where Andrews was born, or if he was really the originator of Moore's Almanac.—T. W. PIPER. Observations during last transit of Venus have not yet been reduced. Thanks for suggestion about KNOWLEDGE; will send to publishers. Do not think the principles of spectrum analysis will be affected if the new views about the luminosity of gas be established.—URSA MAJOR. There is a full account of the Lunar Hoax in my "Myths and Marvels of Astronomy." J. T. S. L. L. Why should those rays turn the earth one way more than another?—JAS. ROWE. Explained in most recent books of Astronomy.—AMY BRIGGS. Your letter soon. Do not myself know.—E. M. J. Thanks for encouraging letter. —J. H. THOMSON. Your letter unfortunately made such travels to reach me, and was so long delayed, that it would have been useless to send the enclosure on. They cannot have been eggs though.

Our Chess Column.

By Mephisto.

SOLUTIONS.

The Arabians, p. 222.

1.	Kt to K4	K to B4	8.	K to B2	K to Kt5
2.	K to K3	K to K4 (best)	9.	Kt to Kt6	K to R6
3.	Kt to B8	K to B4	10.	Kt to B6	K to R7
4.	Kt(B8) to Kt6	K to Kt5	11.	Kt to B4	K to R8
5.	Kt to K7	K to R5	12.	Kt to B5	K to R7
6.	Kt to B5 (ch)	K to Kt5	13.	Kt to Kt4 (ch)	K to R8
7.	Kt to Kt7	K to R5	14.	Kt to Kt3 mate	

If Black plays 2. K to Kt5, White replies at once with Kt to Kt7, and mate follows as above on the 10th move. All Black's other moves are forced. W.

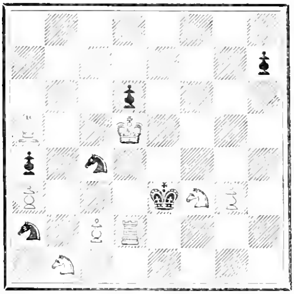
Problem No. 101, by W. Furnival.

1. B to Rsq	1. P to B3
2. R to QKt2	2. P takes Kt
3. R to Kt2, mate.	

PROBLEM No. 102.

By J. A. Miles.

Black.



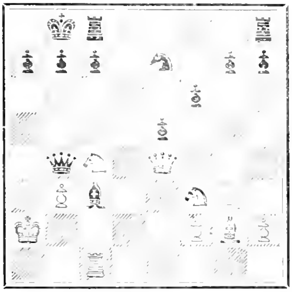
White.

White to play and mate in four moves.

The following termination occurred in a game recently played at Purssell's Chess Room.

Amateur.

Black.



White.

Mephisto.

R takes B !	Q takes R	Q to R4 (ch)	Q to R4
Kt (B3) takes QP	P to B3 (*a*)	Kt takes P (ch)	K to R2
Kt to K7 (ch)	K to R sq	Q takes Q, mate	
Kt(B4) to Kt6(ch)	P takes Kt		

(*a*) If Q to Kt4 instead, then Kt to K7 (ch), K to R sq. Kt (B4) to Kt6 (ch), Q takes Kt. Kt takes Q (ch), and mates next move.

GAME RECENTLY PLAYED BETWEEN MEPHISTO AND A STRONG AMATEUR.

Bishop's Gambit.

	White. Amateur.	Black. Mephisto.		White. Amateur.	Black. Mephisto.
1.	P to K4	P to K4	14.	B to Q2 (*d*)	Castles QR
2.	P to KB4	P takes P	15.	R to K sq	P to Kt5
3.	B to B4	P to Q4	16.	Kt to R2	P to B6
4.	B takes P	Q to R5 (ch)	17.	Q to K3	Kt takes P (*e*)
5.	K to B sq	P to Kt4	18.	P takes Kt	B takes P (*f*)
6.	Kt to QB3	B to Kt2	19.	K to B sq (*g*)	P to B7
7.	P to Q4	Kt to K2	20.	R to K2	KR to K sq
8.	Kt to B3	Q to R4	21.	B to B sq	B takes KKt
9.	P to KR4	P to KR3	22.	R takes B	P to Kt6
10.	K to Kt sq	Q to Kt3	23.	R to R sq	Kt to Q4
11.	P to K5	P to B3 (*a*)	24.	Q to B5 (*h*)	Kt takes Kt
12.	B to Kt3 (*b*)	B to B4		Resigns	
13.	Q to K2 (*c*)	Kt to Q2			

NOTES.

(*a*) So far all are book moves. P to B3 is condemned by the books, but we have found this move answer on several occasions.

(*b*) B to K4 is more in accordance with the spirit of this attack, for after P takes P, P takes P. R takes R, B takes R. P to KKt4 might become dangerous.

(*c*) P to Q5 may likewise be played here.

(*d*) 14. P to R5, Q to R3. 15. P to K6, P takes P. 16. B takes P, Castles, leads to no favourable result.

(*e*) A paying sacrifice.

(*f*) Black could at once regain the piece by P to B7 (ch), followed by P to Kt6, but he prefers to give up another piece for a further attack.

(*g*) Black threatened B to Q5. If White played 19. Q takes B, then R takes B, &c.

(*h*) White's best was to give up his Q for the two Rooks.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. A. Miles.—It is impossible always to be correct in matters problematical. We accept Mr. Planck's opinion.

J. C. Pattesen.—The book of "The London International Tournament of 1883" will appear in January next.

Correct solutions received:—Problem, No. 100: Herbert Jacobs. No. 101: W. Saxon, John Watson, W. Anderson, H. A. D.

G. R. M.—Cook's "Synopsis of Openings."

Leonard P. Rees.—Letter received; reply follows.

An important new work by Robert Hudson Graham, C.E., will be shortly issued by Messrs. Crosby Lockwood & Co., London, entitled "Graphic and Analytic Statics in Theory and Comparison; their practical application to the Treatment of Stresses in Roofs, Girders, Bridges, Arches, Piers, and other Frameworks. With a chapter on Wind Pressures, and a number of Diagrams and Plates to Scale, with examples—many taken from existing structures." The same publishers also announce for immediate publication, "The Art of Soap-Making: a Practical Handbook of the Manufacture of Hard and Soft Soaps, Toilet Soaps, &c." (by Alexander Watt); "The Engineer's and Shipowner's Coal Tables" (by Nelson Foley, author of "The Engineer's Office Book of Boiler Construction"); and the following works in their popular "Weale's Rudimentary Series:"—"Farm Buildings: a Treatise on the Buildings necessary for various kinds of Farms, and their Arrangement and Construction; with Plans and Estimates" (by Professor John Scott, being the fourth volume of Scott's "Farm Engineering Text Books"); and a revised and enlarged edition of "Sanitary Work in the Smaller Towns and Villages" (by Charles Slagg, A.M. Inst. C.E.).

Contents of No. 102.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 26, 1883.

Contents of No. 104.

A NATURALIST'S YEAR.

By Grant Allen.

CHESTNUTS FALL.

On the wooded slope where the park shelves slowly towards the Bourne Brook, the ground to-day is thickly strewn in many places with the sharp prickly husks and small, barren, angular nutlets of the beautiful Spanish chestnuts. They are not truly indigenous to Britain, these noble spreading forest trees, though they have been planted so long in our pleasure-grounds and lawns that we have got to look upon them almost as naturalised British subjects; and the climate, though it suits the leaves and wood well enough, is not sufficiently kindly to ripen the fruits in due season; they are almost always mere empty, shrivelled shells here in England, so that we have to import seed for sowing from the mountain regions of southern Europe. There we have all seen them growing in their own wild luxuriance on the lower escarpments of the Alps or the Apennines, and bringing forth fertile nuts sufficient to feed half the teeming population of the Lombard plain in seasons of scarcity. Side by side with them in the park here, the boys are impartially shying sticks at the very similar, though wholly unrelated, clusters of the common horse-chestnuts, which, in spite of their close external likeness, belong in reality to a totally different and much more restricted family. The true chestnut is a catkin bearer, a near relation of the British oak, as one might almost guess at sight from its foliage and habit: the horse-chestnut is a member of a tribe unrepresented in our native English flora, but not very unlike the maples and sycamores in its principal characters. It is interesting to note how in the case of these two wholly different and originally dissimilar trees similarity of circumstances has at last produced such great similarity of adaptive peculiarities.

The key to this strange resemblance between the chestnut and the horse-chestnut is to be found in the fact that they are both *nuts*—they have survived in the struggle for existence by adopting for their seed-vessels the exactly opposite tactics from those adopted by the true fruits. A fruit, as we have often seen, is a seed-vessel which lays itself out, by all the allurements of bright colour, sweet scent, sugary juices, and nutritive properties, to attract animals who will aid it by swallowing it, and so eventually dispersing its seeds. But a nut is a seed-vessel which, on the contrary, being richly stored with starches and oils for the supply of the young plantlet, would be injured and diverted from its real intent and purport if it were to be eaten and digested by any animal. Accordingly, nuts have concentrated all their efforts upon repelling rather than upon attracting the attention of animals; or, to put it in a more strictly physical way, those nuts which have happened to be least attractive in colour and most protected by hairs, spines, prickles, or bitter juices have best succeeded in escaping the attacks of animals, and so have prospered best in the struggle for existence. Thus, to drop into metaphor once more, while the fruit wants to be eaten, the nut, on the contrary, wants to escape.

We may take the chestnut as a very good example of the general result which the necessity for protection usually produces in these peculiar seed-vessels. While it still grows on the tree the entire fruit is green and unobtrusive, hardly noticeable at a little distance among the heavy foliage which covers it on every side. Compare this shrinking and secretive habit with the brilliancy and vividness of oranges and mangoes, or even of our own bright-coloured northern rose-hips, and haws, and mountain ashes, and holly-berries. Again, instead of being smooth-skinned and soft, like these bird-enticing fruits, the outer rind of the chestnut is rough and repellent with serried prickles, which rudely wound the tender nose of the too-inquisitive squirrel, or even the feathery cheeks of the more protected nut-hatch. Once more, when the separate nuts inside have fallen out upon the ground, they are no longer green like the foliage on the tree, but light brown or "chestnut," like the dead leaves and withered bracken into whose midst they have gently fallen. Chestnuts themselves are apparently sufficiently protected by these devices of colour and prickliness; they do not seem further to require the special nut-like covering of a hard and woody shell; but the filbert, which suffers far more from the depredations of dormice, squirrels, nut-hatches, and other birds or mammals, has not only encased itself without in a green husk covered by sharp and annoying little hairs, but has also acquired a very solid and difficult shell, which often succeeds in baffling even the keen teeth and beaks of its persistent and aggressive animal foes.

Indeed, even among British nuts, one may trace a regular gradation (not, of course, genealogical) from the softest and least protected to the hardest and most defensive kinds. The acorn, produced in vast numbers by a very large and long-lived tree, the oak, has hardly any need of a strong outer coat of armour, especially as its kernel is rather bitter and far from attractive to most animals, though it still feeds a considerable legion of hoarding squirrels, and must once have been munched in immense quantities by the native wild boars, or their mediæval successors, the half-tamed forest swine. In the beech, the shell of the actual nut itself is merely leathery; but the outer coat or involucre is sprinkled over with distinctly protective prickles. (It is worth while to note in passing that the beechnuts or mast rarely contain a kernel in Britain—in other words, they are almost always sterile; whereas in other countries where the beeches are more sturdy, the nuts are usually fertile; and this fact may be put side by side with the correlative fact that the beech is a decadent tree in England, where it was once dominant, but is now rapidly dying out before our very eyes, at least in its indigenous form.) In the lime, the very small nut has a decided shell, while its globular shape also makes it difficult for quadrupeds to open with their paws and teeth. Finally, in the hazel, the filbert has a very hard integument

indeed, and a disagreeable husky covering of smarting hairs.

Our own English nuts are only exposed to the attacks of extremely small and comparatively harmless mammals, or of inconsiderable native birds; and, therefore, their defensive tactics have never been carried any further than in the case of the hedgerow filbert. But in southern climates, and especially in the tropics, nuts are exposed to far larger and more dangerous forestine foes, like the monkeys and parrots, against whose teeth or bills, as we all know, even the solid shell of a Barcelona cob is absolutely no protection. Hence, under these circumstances, only the very hardest or most disagreeable nuts have been able to survive and to grow up in due time into flourishing nut-trees. Sometimes, as in the walnut, the chief protection is afforded by a nauseous outer rind—a system which reaches its climax in the South American cashews, whose pungent juice blisters the skin like a cantharides plaster: sometimes, as in the cocoanut, it is afforded by great thickness and hardness of shell, which sets at nought the most persistent endeavours of the hungry aggressor. In the Brazil nut, a number of sharp, angular nuts are crowded together inside a large and hard outside shell, so that even after the monkey has managed to crack the big outer nut, he has still to open all the inside nuts one by one in detail. It is worth while to notice, too, that an exactly similar modification is undergone in the tropics by the stones of stone-fruits, which are really nuts in disguise, covered only by a soft, sweet pulp that entices animals to aid in dispersing them, by dropping the hard seed on to the ground in favourable spots for its growth. In temperate climates the stones are only hard enough to defy squirrels and birds: in tropical countries they are hard enough to defy monkeys and parrots. Compare, for example, the English sloe or birdcherry with the peach-stone, and the English haw with the mango or the vegetable ivory. This last nut is one of the oddest in the whole range of nature, for it is here the actual kernel itself that grows so hard and horny. Yet even the vegetable ivory, which consists really of very solid starchy cells, softens and yields up its material to the growing plant as soon as the embryo it encloses begins to sprout under the influence of warmth and moisture.

Erratum.—For the papers on "How to Get Strong," by *Mr. Thomas Foster*," in the note on p. 238, read "The papers on 'How to Get Strong,' 'The Morality of Happiness,' by Mr. Thomas Foster," &c.

A Cyprus Snake.—My servant, Anastasi, sat down on the bank to roll a cigarette, and, as he did so, very nearly sat upon a large asp, or kouphía, as the natives call them. It was sluggishly moving away, when Anastasi jumped up and seizing a thick stick, pursued it. An exciting battle ensued, the kouphía making rapid darts at its assailant, and each dart being parried by a dexterous clip from the stick. At last it turned tail, and then got the finishing touch in a heavy blow, which sorely bruised the serpent's head. It was not measured, no accurate measure being at hand; but it must have been at least three feet long, and six or seven inches round the thickest part of the body, which is situated about a third of the length from the head. The shape of this third, including the head, is not round in section, but oval on the back and flat underneath. The colour of this asp—if it be an asp—was silvery grey with large black spots. During its fight the whole skin, including the spots, turned to an ashy grey, but death immediately brought back the original colours. As the struggle lasted fully five minutes, there was ample time carefully to observe this change.—*Cyprus Herald*, Sept. 22, 1883.

HOW TO GET STRONG.*

(*Continued from page* 118.)

Like other subjects, "How to Get Strong," has had to make way for the various items, scraps, and so forth, which it has been thought necessary to reproduce from the records of the British Association meeting. We now return to our subject where it was left at p. 118. We were there entering on the inquiry how far those in advanced and middle life can desirably practise exercises intended to maintain or increase strength and (what is apt to be more markedly deficient in middle life) suppleness. In passing we would note that this section of our subject will for the most part be found interesting, and we hope useful for those who though neither old nor middle-aged require exercises of the same class. Many young men and men who have not as yet reached or passed the prime of life are yet not able to take very energetic exercise, to run long distances, box, fence, ride far, row many hours at a stretch, or the like, but require such moderate and easy exercises as suit men in advanced and middle life.

Just here the question presents itself (it has been repeatedly asked of us since these papers began) Is it well for the weak to take active exercise? Ought not (many ask) weak arms and legs to be left untaxed by systematic exercise? Is it wise or even safe for men of weak lungs to attempt running or other exercises which call the lungs into active play? And many similar questions are asked, in tones implying that those who ask them think the best way to deal with all the weaker muscles and organs of the body, is to employ them as little as possible.

Nature answers for us such questions as these in a very decided and emphatic manner. Persons who exercise those powers which they possess in large degree and avoid exercising those in which they are in greater or less degree deficient, find her rule to be that to the kind of strength they have is added and from that which they want is taken even so much of it as they had possessed. The muscles and organs used grow stronger and more active, those disused grow weaker and less efficient. When therefore a man says, I will not row because my arms and loins are too weak, or I will not run because my lungs are weak and my legs soon tire, he is running directly counter to the teachings of Nature though he may be responding to her promptings. Nature has an ugly way—sometimes—of eliminating inferior things altogether; and what is held to be natural, as the disuse of weak muscles, the resting of weak organs, and so forth, is sometimes only a yielding to this way of Nature's,—leading to the deterioration of what is already inferior the weakening of what is already wanting in strength. Her real teaching is clear enough. It simply is, Be specially careful to exercise, but with due watchfulness and moderation, those muscles and organs which are weak: those which are strong will take care of themselves; you cannot help exercising them. Nor is it an idle assertion that Nature punishes by elimination, when her teachings are overlooked. There are organic diseases, specially liable of course to affect the weaker, which are best resisted and may be cured by proper exercise of the feeble organ attacked, but make rapid progress and finally destroy the organism (along with the being to whom it belongs) when it is left simply to rest.

It is quite true that for weak organs and for weak muscles (which more particularly concern us here), violent exercise may be more directly and quickly mischievous than disuse. For a man with weak lungs, or perhaps in an early stage of some lung-disease, to run at his hardest as

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* *Not* by Mr. Thomas Foster.

long a distance as he possibly can, might very likely cause death within a few minutes, where carefully resting his lungs and taking no exercise which could in the slightest degree hasten respiration, would not very obviously encourage the progress of pulmonary mischief. A man with weak arm muscles, again, might easily, by attempting to lift great weights or to sway unwieldy clubs or dumb-bells, so strain and injure the muscles and tendons of his arms, as to weaken himself much more in a few moments than he would by months of laziness with his arms. There is reason in all things, and the wise rule must be obeyed even in things good—*Ne quid nimis.* But within the limits suggested by reason and moderation, the rules remain sound, Where there is weakness, whether of muscle or organ, there exercise is the right thing; Where there is stiffness, not rest but movement is required.

The great difference between those still young but wanting in strength or lissomness, and those in advanced life, is of course that in one case exercise may be undertaken with the reasonable hope of increasing strength or activity, in the other the aim is rather to check the changes by which in accordance with natural laws the strength and activity gradually diminish with advancing years. Though, even with men in middle and advanced life we often find that muscles and organs which through disuse have been prematurely weakened may be restored to a degree of vigour much nearer the vigour of the prime of life than is commonly supposed. We know a man who ten years ago was much weaker and much less active, and in effect was, at least in one sense of the words much *older*, than he is at the present day. He saw that laziness (bodily laziness at least) was doing more to age him than years; and by steady and even active exercise he has been able to throw off the burden of a round dozen of years at least.

(*To be continued.*)

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXI.

In my last I explained the hardening effect of boiling water on meat, and the consequent necessity of keeping down the temperature considerably below the boiling-point in order to obtain a tender and full-flavoured stew. Some further explanation is necessary, as it is quite possible to obtain what commonly passes for tenderness by a very flagrant violation of the principles there expounded. This is done on a large scale and in extreme degree in the preparation of ordinary Australian tinned meat. A number of tins are filled with the meat, and soldered down close, all but a small pin-hole. They are then placed in a bath charged with a saline substance, such as chloride of zinc, which has a higher boiling-point than water. This is heated up to its boiling-point, and consequently the water which is in the tins with the meat boils vigorously, and a jet of steam mixed with air blows from the pin-hole. When all the air is expelled and the jet is of pure steam only (a difference detected at once by the trained expert), the tin is removed, and a little melted solder skilfully dropped on the hole to seal the tin hermetically. An examination of one of these tins will show this final soldering with—in some—a flap below to prevent any solder from falling in amongst the meat. The object of this is to exclude all air, for if only a very small quantity remains, oxidation and putrefaction speedily ensues, as shown by a bulging of the tins instead of the partial collapse that should occur when the steam condenses, the display of which collapse is an indication of good quality of the contents.

By "good quality" I mean good of its kind; but, as everybody knows who has tried beef and mutton thus prepared, it is not satisfactory. The preservation from putrefactive decomposition is perfectly successful, and all the original constituents of the meat are there. It is *apparently* tender, but *practically* tough—*i.e.*, it falls to pieces at a mere touch of the knife, but these fragments offer to the teeth a peculiar resistance to proper masticatory commination. I may describe their condition as one of pertinacious fibrosity. The fibres separate, but there they are as stubborn fibres still.

This is a very serious matter, for, were it otherwise, the great problem of supplying our dense population with an abundance of cheap animal food would have been solved about twenty years ago. As it is, the plain tinned-meat enterprise has not developed to any important extent beyond affording a variation with salt junk on board ship.

What is the *rationale* of this defect? Beyond the general statement that the meat is "overdone," I have met with no attempt at explanation; but am not, therefore, disposed to give up the riddle without attempting a solution.

Reverting to what I have already said concerning the action of heat on the constituents of flesh, it is evident that in the first place the long exposure to the boiling-point must harden the albumen. *Syntonin*, or *muscle-fibrin*, the material of the ultimate contractile fibres of the muscle, is coagulated by boiling water, and further hardened by continuous boiling, in the same manner as albumen. Thus, the muscle fibres themselves and the lubricating liquor* in which they are imbedded must be simultaneously toughened by the method above described, and this explains the pertinacious fibrosity of the result.

But how is the apparent tenderness, the facile separation of the fibres of the same meat produced? A little further examination of the anatomy and chemistry of muscle will, I think, explain this quite satisfactorily. The ultimate fibres of the muscles are enveloped in a very delicate membrane: a bundle of these is again enveloped in a somewhat stronger membrane (*areolar tissue*); and a number of these bundles or *fasciculi* are further enveloped in a proportionally stronger sheath of similar membrane. All these binding membranes are mainly composed of gelatine, or the substance which (as explained in No. 5) produces gelatine when boiled. The boiling that is necessary to drive out all the air from the tins is sufficient to dissolve this, and effect that easy separability of the muscular fibres, or fasciculi of fibres, that gives to such overcooked meat its fictitious tenderness.

I have entered into these anatomical and chemical details because it is only by understanding them that the difference between true tenderness and spurious tenderness of stewed meat can be soundly understood, especially in this country, where stewed meats are despised because scientific stewing is practically and generally an unknown art. Ask an English cook the difference between boiled beef or mutton and stewed beef or mutton, and in ninety-nine cases out of a hundred her reply will be to the effect that stewed meat is that which has been boiled or simmered for a longer time than the boiled meat.

* I have ventured to ascribe this lubricating function to the albumen which envelopes the fibres, though doubtful whether it is quite orthodox to do so. Its identity in composition with the synovial liquor of the joints, and the necessity for such lubricant, justify this supposition. It may act as a nutrient fluid at the same time.

She proceeds, in accordance with this definition, when making an Irish stew or similar dish, by "simmering" at 212° until, by the coagulation and hardening of the albumen and syntonin, a leathery mass is obtained; then she continues the simmering until the gelatine of the areolar tissue is dissolved, and the toughened fibres separate or become readily separable. Having achieved this disintegration, she supposes the meat to be tender, the fact being that the fibres individually are tougher than they were at the leathery stage. The mischief is not limited to the destruction of the flavour of the meat, but includes the destruction of the nutritive value of its solid portion by rendering it all indigestible, with the exception of the gelatine which is dissolved in the gravy. This exception should be duly noted, inasmuch as it is the one redeeming feature of such proceeding that renders it fairly well adapted for the cookery of such meat as cow-heels, sheeps' trotters, calves'-heads, shins of beef, knuckles of veal, and other viands which consist mainly of membranous, tendinous, or integumentary matter composed of gelatine. To treat the prime parts of good beef or mutton in this manner is to perpetrate a domestic atrocity.

I am not yet able to record the result of stewing a sirloin of beef in accordance with the scientific principles expounded in my last. Have no hopes of being able to do so until I can spare time to stand by the kitchen fire with thermometer in hand from beginning to end of the process, or have constructed a stewing-pot, big enough for the purpose, so arranged that its contents cannot possibly by any effort of ingenious perversity be raised above 180°. The domestic superstition concerning simmering is so widespread and inveterate that every normally-constituted cook stubbornly believes that simmering water is of much lower temperature than boiling water, and, therefore, any amount of instruction or injunctions for the maintenance of a heat below boiling will be stubbornly translated into an order for "gentle simmering," a quarter of an hour of which would spoil the sirloin.

I may, however, mention an experiment that I have made lately. I killed a superannuated hen—more than six years old, but otherwise in very good condition. Cooked in the ordinary way she would have been uneatably tough. Instead of being thus cooked, she was gently stewed about four hours. I cannot guarantee to the maintenance of the theoretical temperature, having suspicion of *some* simmering. After this she was left in the water until it cooled, and on the following day was roasted in the usual manner, *i.e.*, in a roasting oven. The result was excellent; as tender as a full-grown chicken roasted in the ordinary way, and of quite equal flavour, in spite of the very good broth obtained by the preliminary stewing. This surprised me. I anticipated the softening of the tendons and ligaments, but supposed that the extraction of the juices would have spoiled the flavour. It must have diluted it, and that so much remained was probably due to the fact that an old fowl is more fully flavoured than a young chicken. The usual farm-house method of cooking old hens is to stew them simply; the rule in the Midlands being one hour in the pot for every year of age. The feature of the above experiment was the supplementary roasting. As the laying season is now coming to an end, old hens will soon be a drug in the market, and those among my readers who have not a hen roost of their own will oblige their poulterers by ordering a hen that is warranted to be four years old or upwards. If he deals fairly he will supply a specimen upon which they may repeat my experiment, very cheaply. It offers the double economy of utilising a nearly waste product and obtaining chicken-broth and roast fowl simultaneously.

One of the great advantages of stewing is that it affords a means of obtaining a savoury and very wholesome dish at a minimum of cost. A small piece of meat may be stewed with a large quantity of vegetables, the juice of the meat savouring the whole. Besides this, it costs far less fuel than roasting.

The wife of the French or Swiss landed proprietor, *i.e.*, the peasant, cooks the family dinner with less than a tenth of the expenditure of fuel used in England for the preparation of an inferior meal. A little charcoal under her *bain-marie* does it all. The economy of time corresponds to the economy of fuel, for the mixture of viands required for the stew once put into the pot is left to itself until dinner-time, or at most an occasional stirring of fresh charcoal into the embers is all that is demanded.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

(*Continued from page 200.*)

We approach now the heart of the matter. We have seen how conduct has been evolved in the various races of living creatures, from the lowest to man the highest. We have learned how closely related are men's ideas of good and bad to that which is the chief end of all conduct—the preservation and extension of life. And we have found that while the conception of rightness and wrongness is not very marked in relation to conduct affecting self-life, it becomes clear and obvious in relation to conduct affecting the life of offspring, and attains its greatest definiteness and as it were emphasis in its application to conduct affecting the lives of others. Where the rules determining right and wrong in regard to the life of self, of offspring, and of others, come into conflict, as they must until social relations become perfect, the right in regard to self mostly gives way to right in regard to offspring, and both usually give way to right in regard to the rest of human kind. But in Mr. Spencer's words (I quote them with emphasis) because he has been so preposterously and indeed wickedly charged with teaching a very different doctrine) "the conduct called good rises to the conduct conceived as best, when it fulfils all three classes of ends at the same time.

But now the vital question of all comes before us.

We conceive as good or bad such conduct as conduces or the reverse to life and the fulness of life, in self and others. But is conduct of the one kind really good or conduct of the other kind really bad? Though good or bad with reference to that particular end, and though held to be right or wrong because that end is actually in view among men, may not conduct be differently judged when the nature of that end is considered? In other words, the question comes before us, Is life worth living? We need not take either the optimist view according to which life is very good, or the pessimist view according to which it is very bad. But each one of us from his experience as regards his own life, and from his observation (often most misleading, however) on the lives of others, may be led to hold that on the whole life is good, or that on the whole it is bad. Of course in the very theory of the evolution of conduct, or rather in the series of observed facts demonstrating the evolution of conduct, we see that life and the fulness of life are fought for throughout nature as if they were good. In the highest race the love of life in self, which assumes that the life of others also is good, has attained its highest expression. "Everything that a man has he will give for his

life," is a rule established rather than shaken by exceptions and the attention directed to such exceptions. Yet the mere fact that life is fought for by all, and that the struggle for life has been so potent a factor in the development of life, does not in itself prove life to be an actual good. Death comes not alone. To creatures full of life Death comes in company with Pain and Suffering. It may be these which move all living creatures to struggle for life, and not mere fear of Death.

Now, to the question, Is life worth living? it would be impossible to give an answer that would suit all. Probably there have not been two human beings since the world was made who, could they express their precise opinion on this point, would give precisely the same answer. Many whose whole lives have been full of sorrow and trouble, who have had occasion many times to say that man was born to sorrow, would yet, even taking survey of their own sad lives, say,—Life is sweet. That many whose own lives have been bitter enough, think yet that life is sweet, is shown by this that among them have been found those who have done most to foster the lives of others. But many of them would say that life is sweet, speaking even from their own experience of life. And on the other hand many who are held by those around them to have had little sorrow, who from childhood to old age have scarce ever known pain or suffering, who have had more than their fill of the pleasures of life, and have escaped the usual share of life's afflictions, would speak of life as dull and dreary if not bitter. It has been indeed from such men that the doubting cry has come, Is life worth living? Men of more varied experience would give other answers to that vain question. All answers indeed must be as idle as the question itself. Yet most men would give the answer which says most for the pleasantness of life,—that, as a whole, life is neither bitter nor sweet, neither sharp nor cloying, but that it "has all the charm in bitter-sweetness found."

We are not concerned, however, to inquire what is the true answer to the question, Is life worth living? Though it is clear that if life is not worth living the observed action of evolution has been unfortunate, and the resulting laws of conduct are a mistake, while the reverse must be held if on the whole life is well worth living, yet so far as our subject of inquiry is concerned, it matters not which view we take. That which is common to both views is all we have to consider. The man who holds that life is worth living, so thinks because he believes that the pleasures of life on the whole outweigh its pains and sorrows. The man who holds that life is not worth living does so because he thinks that the pains and sorrows of life outweigh its pleasures. So much is true independently of all ideas as to what are the real pleasures or the real pains of life, or whether life here is most to be considered or chiefly a future life with pleasures or pains far greater in intensity and in duration than any known here.

Where or what the chief pleasures or pains of life may be, when or how long endured, in no sort affects the conclusion that life is to be considered worth living or the reverse according as happiness outvies misery or misery happiness, and that therefore the rightness or wrongness of conduct must be judged not by its direct action on life and the fulness of life but by its indirect influence in increasing or diminishing the totality of happiness. To quote again the words of the great teacher who is so often misquoted and so much misunderstood :—

"There is no escape from the admission that in calling good the conduct which subserves life, and bad the conduct which hinders or destroys it, and in so implying that life is a blessing and not a curse, we are inevitably asserting that conduct is good or bad according as its *total** effects are pleasurable or painful."

(To be continued.)

THE FISHERIES EXHIBITION.

By John Ernest Ady.

VIII.

THE next groups of organisms which claim our attention are those which come under the zoological class *Actinozoa*. These animals comprise the sea-anemones, the corals, and the delicate pelagic *Ctenophora*. All these orders are well represented in the Exhibition. We refer the reader to Mr. Kimber's papers in this journal for a brief sketch of the structure † and a detailed account of some of the beautiful sea-anemones ‡ which form a most attractive feature of the aquarium tanks.

To Mr. Kimber's description of the structure of a sea anemone it may be added that when the body is examined minutely with the microscope, it is found to consist of two layers, as in the *Hydrozoa*,‖ viz., the ectoderm and endoderm, and that between these comes a third layer or mesoderm, which gives rise to the bands of muscular fibres, &c.

The sea-anemones are typical of the whole order *Actinozoa* in all essential particulars; but more strictly are they types of a particular group termed the "Helianthoid Polypes," or *Hexacoralla*. They are so-called because of the disposition of their soft parts, tentacles, &c., in multiples of six, but occasionally of five. The members of the section appropriated by Mr. Kimber are all soft polypes—that is, they seldom possess any skeleton, and where one does exist it obtains in the form of a spurious arrangement (of scattered spicules). They are almost invariably simple, although compound species do exist, as in our old commensal friend the *Palythoa* on the glass-rope sponge, and in *Zoanthus*. They usually have a base by which they attach themselves to foreign objects, but *Ilyanthus* and others lead a free existence.

The vast majority of the compound sea-anemones, however, secrete a skeleton, and these skeletons are popularly known as corals. Now, corals are of two kinds, and these are so very different from each other that they may be distinguished and separated at a glance. Imagine a group of sea-anemones united to each other by their bases, so as to form a compound, stem-like structure. The common flesh, which is the bond of union of the separate *polypes* (as each

* I have ventured to emphasise this word (though the emphasis is not necessary for the ordinarily attentive), simply because so many have either actually misunderstood Mr. Spencer's saying here, or else have pretended to do so. The word emphasised makes the saying not only true but (as it was intended to be) obviously true. Mr. Spencer is here purposely stating a truism, or what ought to be a truism. No matter what a man's doctrine in religious matters may be, no matter what his views as to a future state, the saying above quoted is absolutely true. It is true in small matters as well as in great. By overlooking the word "total," or by treating the saying as though for the word "total" the word "immediate" might honestly be substituted, the saying expresses what Carlyle contemptuously called pig-philosophy; but Spencer's actual saying is about as remote from pig-philosophy as any teaching well could be. It inculcates a philosophy more truly regardful of self than the sheerest egoism, more justly and beneficently regardful of others than the purest altruism.

† See Knowledge, July 13, 1883, p. 22, *et seq.*
‡ See Knowledge, pp. 89, 115, 187, 214.
‖ See Knowledge, p. 180, *et seq.*

sea-anemone is termed), is called the *cœnosarc*, and from this the pretty little polypes bud forth outwardly in all directions. Suppose that the polypes themselves are entirely soft, like ordinary sea-anemones, but that the cœnosarc, or common basal foot of the colony, secretes a horny or calcareous skeleton. It is then evident that if the compound creature is tree-like in form, as it usually is, that a solid axial support would be the result; and such we find to be the case in the black coral (*Antipathidæ*).

In another order of corals called the "Asteroid Polypes," or *Octocoralla*, the main difference from the foregoing consists of the disposition of soft parts in fours and multiples of four, usually eight. And here we have a vast assemblage of lovely animals both in the flesh and in skeletons. Let us look at some of them. The Sea Pens and Virgularias may be seen almost in their vital beauty in Dr. Anton Dohrn's series of museum specimens from the zoological station of Naples, to which we lately drew special attention. The beautiful red and yellow Gorgonias or Sea Shrubs are well known to every collector of pretty objects of natural history, and are arranged with neat care and precision under many a highly-prized glass-shadeful of lovely objects in the natural history galleries of the East Quadrant. Whilst the valued red coral of commerce (*Corallium rubrum*), in tiaras, necklets, bracelets, and rings, &c., need not be localised, since they are so attractively displayed that they cannot well be overlooked. All these are called *sclerobasic* or foot-secreted corals, and they all agree in the possession of a solid axial skeleton, to which the polypes themselves do not directly contribute.

But the case is very different with those other forms of coral called *sclerodermic*. In these the skeleton or *corallum* is secreted by the polypes, and, therefore, the separate polypes, with their mesenteric septa all calcified, are obvious in the skeleton. Amongst the *Hexacoralla* several familiar examples of exceptional beauty may be seen in Lady Brassey's case, of which we may particularly mention the large brain corals (*Meandrina cerebriformis*), and the star corals (*Astræa pallida*). One or two specimens of the curious fungus coral (*Fungia lacerta*) which belongs to this group, may also be noted. The Asteroid Polypes or *Octocoralla* are represented in Dr. Dohrn's collection by several very fine specimens with all their polypes protruded and their tentacles well spread out. The familiar "Dead-men's fingers," which are so commonly washed on to our sea-shores, and which possess pretty knotted spicules in their tissues, and the red organ-pipe coral (*Tubipora musica*), which is such a favourite for glass shades, also belong to this group of tissue-secreting corals.

Lastly, in Lady Brassey's case there are several corals (*Distichopora Brasseyi*, *Stylaster sanguinea*, &c.) which were formerly regarded as *Actinozoa*. But the careful researches of Mr. Moseley, of H.M.'s *Challenger*, have shown that they are more nearly related to the *Hydrozoa*; he therefore placed them in a group by themselves, the *Hydrocorallinæ*. The life-histories of some of these forms worked out by Mr. Moseley, are pleasingly related by Sir Wyville Thomson in his volume on the Atlantic.

Apart from their utility as ornaments, corals are worthy of special notice, inasmuch as they play and have played an important part in the evolution of the earth's crust. With the single exception of the mollusca, they are perhaps the best guide to the student of stratigraphical geology. The question of the formation and destruction of coral reefs and coral islands which for years puzzled physiographists is now a matter which every junior biological student listens to with interest from the professorial orator, as he narrates, step by step, the manner in which those structures are reared up and destroyed; but it required the genius of such men as Darwin and Dana to place these beautifully simple facts into the order of a philosophical problem; and we cannot do better here than quote the words of Murray, which, as Thomas Carlyle would have said, "puts the whole thing into a nutshell":—

"Darwin's theory may be said to rest on two facts—the one physiological, and the other physical; the former that those species of corals whose skeletons chiefly make up reefs cannot live in depths greater than from twenty to thirty fathoms; the latter, that the surface of the earth is continually undergoing slow elevation or subsidence."

"The corals commence by growing up from the shallow waters surrounding an island, and form a fringing reef, which is closely attached to the shore. The island slowly sinks, but the corals continually grow upwards, and keep the upper surface of the reef at a level with the waves of the ocean. When this has gone on for some time, a wide navigable water channel is formed between the reef and the shores of the island, and we have a barrier reef. These processes have but to be continued some stages further, when the island will disappear beneath the ocean, and be replaced by an atoll with its lagoon where the island once stood."

"According to this simple and beautiful theory, the fringing reef becomes a barrier reef, and the barrier reef an atoll by a continuous process of development."

But although Darwin's theory accounts for the formation of these structures adequately, Murray goes on to show in the same paper* that the theory of subsidence and elevation need not be called in at all to account for these phenomena, but that they may arise in the ordinary sequence of events after different modes, and, moreover, that they usually do do so. We cannot here enter into the details of this subject, and must therefore refer the reader to Mr. Murray's paper, which, although strictly scientific, possesses that degree of general interest which a clearly-written article on a novel subject ought to have.

Finally, those delicate Cœlenterate animals termed *Ctenophora* are transparant oceanic creatures, which swim about through the agency of ctenophores, or comb-like parallel rows of cilia. And once more shall we have to visit Dr. Dohrn's collection to see examples such as *Beroe*, &c., perfectly preserved.

We have neither time nor space to deal with the Annelids, Crustaceans, or Molluscs, although the last two classes of animals find an important place in the fisheries of the world. We may, however, notice one or two articles of peculiar interest. In the Bahamese section several beautiful pink pearls derived from the large conch-shell may be seen. In Lady Brassey's case and a few other cases in the East Quadrant there are a few Buddha shells. These are the valves of a species of mussel (*Anodonta*), into whose substance little models of Buddha are incorporated; whilst the mollusc is yet alive the models are introduced between its mantle and shell, and in the course of time the former secretes a nacreous coat of mother-of-pearl over the mythical casts.

We trust our readers will forgive us for the long interval between the first and concluding portions of Professor Cayley's "Philosophy of Mathematics." The laws of space though they may be set aside by mathematicians of the Inconceivable School are unfortunately inexorable towards editors. For a similar reason our discussion of "The Green Sun in India" is delayed for a week. Next week the papers on the "Earth's Rotundity" will be resumed.—Ed.

* "Proc. Roy. Soc. Edin.," Vol. X., 1879-80, p. 505, *et seq.*

THE SUN'S DISTANCE.*

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

(*Continued from page* 199.)

ONE of the most celebrated methods of measuring the distance of the sun is derived from a combination of experiments on the velocity of light with astronomical measurements. This is a method of very great refinement and beauty, and although it does not satisfy all the necessary conditions, it is impossible in this lecture to avoid a brief reference to an investigation so remarkable.

The principle of this method is easily enunciated. Though the velocity of light is stupendous, yet it has been possible to measure that velocity by experiment. The best determinations indicate that a ray of light would flash over a distance equal to seven times the circumference of the earth in a single second of time (300,400 kilomètres). A ray of light would travel from Southport to London in about the thousandth part of a second. The dimensions of the solar system are, however, so considerable that even a sunbeam requires an appreciable interval of time to span the abyss which separates the earth from the sun. Eight minutes is approximately the duration of the journey. In fact, if the sun were to be suddenly blotted out, it would still be seen shining brilliantly for eight minutes after it had really disappeared. Viewed as a means of measuring the sun's distance, it would be necessary to determine this interval accurately to half a second.

Does astronomy hold out any prospect of our being able to measure this interval with such nicety? This question is intimately connected with two of the most brilliant discoveries in the annals of astronomy. Although they are well known to every one who has paid any attention to this science, yet I must refer to them briefly to examine how far they admit of the needful precision.

Every one who has had the opportunity of using an astronomical telescope is familiar with the exquisite system of four moons which grace the great planet Jupiter. These little bodies led 200 years ago to the discovery of the velocity of light. In their frequent revolutions the little satellites plunge occasionally into the vast and dense shadow thrown by the mighty planet. The sun's light which had previously rendered the little satellite a glittering point of light is then cut off, the satellite becomes invisible, and we say that it is eclipsed. This is a most pleasing phenomenon to witness, and as the satellites revolve so rapidly, the eclipses occur with great frequency. From the discussion of previous observations of the satellites we have become aware of the nature of their movements, so that the advent of eclipses can be predicted, and even the time of their occurrence. But the time at which the eclipse takes place is not identical with the moment at which we see the eclipse. There is an old story of the French King who came to the observatory to see an eclipse; unfortunately his Majesty was late, the eclipse had passed, and when this was explained to him, he wanted to know if it could not be done over again. The only way in which an eclipse could be done over again would be first to view the eclipse from Jupiter himself, and then, with the quickness of thought, to be transferred to the earth, from whence the very same eclipse would be seen a second time. As long as the little satellite is shining it radiates a stream of light across the vast space between Jupiter and the earth. When the eclipse has commenced, the little orb is no longer luminous, but there is, nevertheless, a long slender stream of light on its way, and until all this has poured into our telescopes we still see the little satellite shining as before. If we could calculate the moment when the eclipse really took place, and if we could observe the moment at which the eclipse is seen, the difference between the two gives the time which the light occupies on the journey. At both extremities of the process there are characteristic sources of uncertainty. The occurrence of the eclipse is not an instantaneous phenomenon. The little satellite is large enough to require an appreciable time in crossing the boundary which defines the shadow, so that the observation of an eclipse is not sufficiently precise to form the basis of an important and accurate measurement. Still greater difficulties accompany the attempt to define the true moment of the occurrence of the eclipse as it would be seen by an observer in the vicinity of the satellite. For this we would require a far more perfect theory of the movements of Jupiter's satellites than is at present attainable. This method of finding the sun's distance holds out no prospect of a result accurate to the one thousandth part of its amount, and therefore we may discard it.

But there is yet another method by which the experimental determination of the velocity of light can be so combined with purely astronomical measurements as to yield the sun's distance as a result. Time will not permit that I should enter into this subject, which is identified with one of the most glorious discoveries of astronomy—namely, the aberration of light. But here I would only remark that this method does not fulfil the condition of geometrical necessity. It has not even the somewhat inferior attribute of dynamical necessity. The physical conceptions introduced may to some degree be open to question. Is it certain that the velocity of light in air must be the same as the velocity of light through space? Is it certain that the motion of the whole solar system can be suitably allowed for and eliminated? The time has not yet arrived when this latter question can be fully answered.

(To be continued.)

* A discourse delivered at the second general meeting of the British Association at Southport.

The Sunday Lecture Society.—The fourteenth annual meeting of this society was held on Friday, October 5, at 13, Doughty-street, Holborn, under the presidency of Mr. W. H. Domville, the hon. treasurer. Mr. M. E. Marsden, the hon. secretary, read the report for the past year, from which it appeared that in the session 1882-83, 21 lectures had been delivered by lecturers eminent in science, history, literature, and art, which were attended in the aggregate by 10,587 persons, as against 9,806 attending 24 lectures in the preceding session. After payment of all expenses, there remained a balance in hand of £11 odd. There was a slight increase in the number of members. The committee noted with much satisfaction the continued success of kindred associations at Birmingham and Glasgow, and of efforts to establish similar societies in Edinburgh, Newcastle-on-Tyne, and other large cities and towns. The committee expressed great regret at the loss by death of Mr. William Spottiswoode, the late President of the Royal Society, and a Vice-President of the Sunday Lecture Society, as well as one of its earliest members. He always took a warm interest in the work of the society. On the motion of the chairman, who said the society was financially in a better position than it had ever been before, the report was unanimously adopted. Votes of thanks to the treasurer and secretary, the lecturers, stewards at the lectures, and the auditors closed the proceedings.

NIGHTS WITH A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

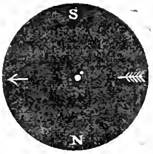
CAPRICORNUS is the next constellation which will claim our attention. It will not, however, detain us long here, as the objects in it identifiable upon the Map on p. 214, Vol. II., are not numerous. The first of them is that beautiful star, ρ Capricorni, represented in Fig. 59. The contrast of colour is fine. o^2 is a pretty little pair, sufficiently wide apart to be resolvable with the lowest eye-piece. 30 Messier, with a power of 70 or so, will be seen as a rather dim-looking nebula with an 8th magnitude star just preceding it (*i.e.*, with an inverting eye-piece, to the left of it). It may be fished for to the left and below ζ Capricorni, just above a line joining ζ with Fomalhaut and (roughly) at a sixth of the distance.

Aquarius, a large constellation extending from the south-east corner of Aquila over the north and to the east of Capricornus, is replete with objects of interest suitable to the instrument we are employing. Numerous others too small for inclusion in the Knowledge maps may be picked up by a systematic search. Proceeding, as is our wont, in the order of Right Ascension, the first object we arrive at is Herschel IV., 1, a very fine specimen of a planetary nebula. Somewhat resembling Uranus, but without his sharp outline, it is rather less than $1\frac{1}{2}^\circ$ to the west of ν Aquarii. Our next object, as it happens, is a nebula too, but of a totally different character. This is 2 Messier,

Fig. 59.

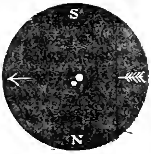
ρ Capricorni.

Fig. 60.



41 Aquarii.

Fig. 61.

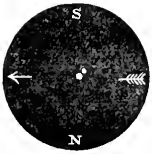


ζ Aquarii.

a large, bright (and for a nebula), conspicuous object. It is about 5° north and only *just* to the east of β Aquarii. About 4° to the east by south of δ Capricorni will be found that delicate little pair 29 Aquarii, its components lying diagonally across the field. If we draw an imaginary line from δ Capricorni to Fomalhaut, at rather more than one-third of the distance from the former star, we shall come upon even a prettier star still, 41 Aquarii, shown in fig. 60. ζ Aquarii is another beautiful object, closer than either of the last described, but perfectly easy with three inches of aperture and a power of 160. It is shown in fig. 61. τ^1 (just below and to the right of τ^2 in the Map on p. 294, Vol. II.) is wide, but very difficult, from the smallness of its companion, which will be glimpsed to the right and a little above the larger star. ψ^1 is another wide pair, but interesting from the colour of its components, which are orange and blue. It will be found over the letter A in the middle of the word "Aquarius" in the Map on p. 294, Vol. II. Below the three stars lettered ψ, and at the right-angle of a rudely right-angled triangle which it forms with them and δ, lies 94 Aquarii, with its gracefully-contrasted colours. Lastly, reference to the Map will show a little group of stars to the right of 2 Ceti. The left hand of the three contiguous ones is 107 Aquarii, which is represented in Fig. 62. Here again varied colours come in as an adjunct to, or element in, the beauty of the object.

Over the western part of Aquarius we shall find Equuleus in the Map. The second star to the right of the one marked 1 there is No. 376 of Piazzi's Hour XX., which we have represented in fig 63, and which will well repay examination. Here again in this pretty close pair we have to note beautifully-contrasted colours. ε Equulei

Fig. 62.



107 Aquarii.

Fig. 63.

P XX 376 Equulei.

(the star marked 1 in the map), which we shall see as a double star, is really a triple system; but the extreme closeness of the companion of the larger star places it hopelessly beyond the reach of our aperture. λ Equulei, represented in fig. 64, is a charming and delicate pair, but quite easy to divide with our instrumental means. Both components are white.

Adjoining Equuleus to the east, is the large constellation Pegasus. 1 Pegasi, bordering on Vulpecula, is a very wide pair. It is inserted here for the finely-contrasted colours of its components. If we join ε Pegasi and δ Equulei by an imaginary line and consider this as the base of a very squat triangle having its apex to the north, then at this apex will be found 15 Messier Pegasi, a fine object, presenting the appearance of a bright nebula, with marked central condensation. It is really a brilliant cluster of stars, but a three-inch telescope is quite impotent to resolve it. ε Pegasi is a very wide triple, but the colours render it interesting. κ Pegasi will tax both the eye and the instrument of the student severely. In fact, to see the minute comes at all he must remain in the dark for some little time, and even then he will only glimpse it "out of the corner of his eye." It is some 12″ from its primary, below and to the left of it. We cannot give a diagram of it to scale, inasmuch as the minute star would not print at all.

Fig. 64.

λ Equulei.

Fig. 65.

51 Piscium.

Fig. 66.

65 Piscium.

Bounded by Pegasus, Aquarius, Cetus, Aries, and Andromeda, is the straggling and not very intelligible constellation Pisces. If we draw an imaginary line from γ Pegasi to η Ceti, about one-third of the way from the first-named star we shall come upon 51 Piscium, a wide but very pretty pair represented in fig. 65. Note the lilac tint of the small companion. 55 Piscium, our next object, will be found some 7° along a line through δ and ε Andromedæ. The components of this charming object are very much closer than those of the previous one, being, in fact, something like one-fifth of the distance. The comes, though minute, will be detected without difficulty. About half-way between π and η Andromedæ we come upon 65

Piscium, a fine and rather close pair of very nearly equal stars. This is shown in Fig. 66. ψ' Piscium, the small unnamed star to the south-east of η Andromedæ, on the Map on p. 294, Vol. II., is another equal pair, but very considerably wider apart, and easily separable with the lowest eye-piece. ζ is also a very wide and easy star, but in this case the components are unequal. The last object identifiable from the map we are using is the leading star in the constellation, α. This fine pair is represented in Fig. 67.

Fig. 67. Fig. 68.

α Piscium. ι Trianguli.

Before quitting this region of the sky we will just direct our instrument to that lovely little pair ι Trianguli, which we inadvertently omitted while describing the constellation Aries on p. 220 of Vol. I. of Knowledge. It is not lettered in the Map to which we have so often referred, but is the star over the letter U in "Triangula." Its aspect is shown in Fig. 68. Its finely-contrasted colours are unfortunately incapable of reproduction on a wood-block.

Note.—The engraver (not for the first time) has failed to reproduce the different depths of shade in the drawing of the Lunar Crater, Aristarchus, and Herodotus, on p. 122. As a slight and partial correction, the student is recommended to pass a pale wash of Indian ink over the interior of Herodotus.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

VII.—THE PARASITE.

Actinia parasitica (Johnston). *Actinia effœta* (Rapp).

ACTINIA PARASITICA, though of large size and imposing appearance, and for a long period well known on the shores of the Mediterranean, has but recently been recognised as a British species.

This anemone in its natural state inhabits deep water, and is generally attached to some univalve shell. It is believed that Parasitica never voluntarily selects an empty shell, nor one occupied by the living mollusk; but nearly always one that is tenanted by the hermit crab (*Pagurus Bernhardus.*) Adult specimens almost invariably attach themselves to old whelk-shells (*Buccinum undatum*). They are met with on the beach after storms, and the oyster-dredge brings up shells invested with them, which are thrown away by the fishermen as refuse.

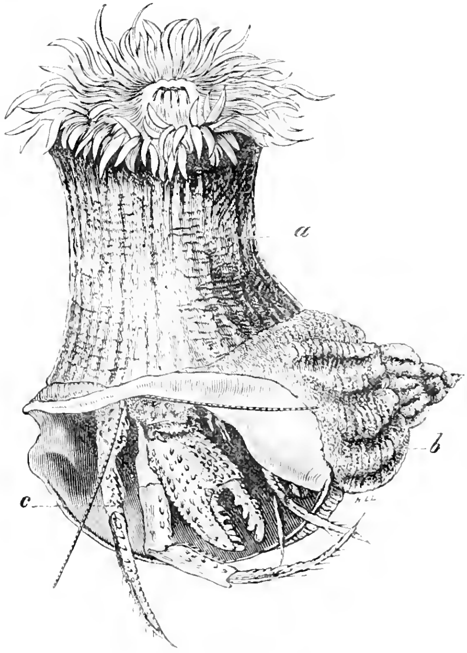
The disk is yellowish white, tinged with purple near the tentacles; in form, slightly concave, like a saucer; and occasionally it is undulated. The radii (except the gonidal) are not strongly marked. The cream-white mouth is raised on a cone.

The tentacula spring from the disk at about half-radius. They are numerous, and roughly estimated at 500, arranged in seven rows; those in the innermost row being the longest, which, when extended, are about an inch long and the eighth of an inch in thickness. In colour, they are sometimes white, at others purple and white, and in some cases tinged with cream colour.

The column attains a height of four or five inches, and a diameter of half its height. Dark-brown bands run from the top to the bottom, and fainter transverse lines cross these bands, forming a cancellated pattern, which is more plainly visible on the upper part. Its normal figure has been compared to a dice-box; but it is constantly varying its form, which is, however, very graceful at all times.

Parasite should never be forcibly removed if it can possibly be avoided, as specimens are often fatally injured in the operation.

The body when closed (in button form) resembles a blunt sugar-loaf, handsomely coloured with buff, lilac, and white.



a. The Parasitic Anemone.
b. Whelk Shell. *c*. Hermit Crab.

This lovely and delicate creature also likes to be well fed, and will not thrive without it. Pieces of raw meat or fish are eagerly devoured by it.

In public aquaria, strict attention can seldom be given to feeding, yet many *actiniæ* will live for lengthened periods under this regimen; but they must and do deteriorate. Many cases are recorded of extreme endurance when removed from their natural element. Mr. Gosse narrates that a *parasitica* with other species were placed in a jar with moist sea-weed without any water, and kept imprisoned therein for ten days; they were then restored to the aquarium in good condition, and showed no sign of having suffered from the treatment. This strong fact appears to prove that an international exchange or transmission of sea anemones is quite practicable, and it

also points out an easy method of carrying out such a project.

The addition of the finest examples from the southern shores of Europe and from the coasts of America might easily have rendered this display at the Fisheries not only the largest, but, at the same time, the most varied and complete that had hitherto been witnessed. At present, no foreign specimens are exhibited, and it is to be feared a great opportunity has been lost of making the anemone exhibition, as it surely might have been made, a world-wide emporium for the reception and comparison of the finest known specimens.

Dr. Ball's experiment, made apparently with a view of demonstrating the peculiar preference of this species for the society of the hermit crab, has been humorously narrated by Dr. Wright, of Dublin, and briefly is somewhat as follows:—One of the specimens attached to the shell of a *Buccinum undatum*, which it was inferred had only just been deserted by a *Pagurus*, was placed in a glass aquarium. In a short time the anemone left the *Buccinum* and attached itself to the side of the tank; it next deserted this position and fixed itself on a large stone. After the lapse of some weeks a hermit crab was dropped into the tank, and he was not long there before he walked up to the whelk-shell, and, after a slight survey, backed into it. I suppose this was a state of affairs the parasite perched on the rock above had long been waiting for; for it was not long in moving its disk over the top of the small whelk, and before the crab knew where he was, parasite had pitched his tent on the roof of the hermit's house. Where the hermit crab goes, there goes parasitica; a quiet life it led before, a restless one it has to lead now. But doubtless it knows what is best for it.

Parasitica, and in the same way Dianthus, Bellis, and some other species, when irritated, will shoot out from all parts of the surface of their bodies, as well as from their mouths, long white filaments to the length of from four to six inches. These filaments, which exactly resemble white sewing-cotton, are believed to be the anemone's weapons of defence. No species is so copiously supplied with them as the parasite, and when very much disturbed a huge bundle is ejected from the mouth. After a time they are all retracted.

Other species of anemones, as *Gem*, *Strawberry*, *Dahlia* (which we purpose hereafter to describe), never eject these filaments, and from this circumstance Mr. Gosse, in "Actinologia Britannica," has named this family of anemones *Sagartiadæ*, to indicate the *genera* which emit these fleshy cords. The name was suggested by the following passage in Herodotus that describes a singularly primitive style of fighting practised by the *Sagartians*, who formed part of the army collected by Xerxes on his invasion of Greece.

There is a certain nomadic race called Sagartians, of Persian extraction and language. They furnish 8,000 horse, but they are not accustomed to carry arms of either brass or iron, except daggers. They use ropes made of twisted thongs. Trusting to these they go to war. The mode of fighting of these men is as follows: When they engage with the enemy, they throw out the ropes, which have nooses at the end, and whatever any one catches, whether horse or man, he drags towards himself, and they that are entangled in the coils are put to death.—Herod. vii. 84.

The proportion of doctors to the population in different countries is given as follows by the *Siglo Medico*:—France, 2·91 per 10,000; Germany, 3·21 per 10,000: Austria, 3·41 per 10,000: England, 6 per 10,000: Hungary, 6·10 per 10,000; Italy, 6·10 per 10,000: Switzerland, 7·06 per 10,000; United States, 16·24 per 10,000.

TRICYCLES IN 1883.

SMALL WHEELS *VERSUS* LARGE.

[I have received several letters from a valued correspondent who has read my articles in Knowledge on "Tricycles"—the Rev. J. M. Taylor, of Seer Green Vicarage, Beaconsfield. These letters contain so much of interest on the question of the size of wheels and the weight of machines, and also a statement of the *rationale* of rubber, so concisely and admirably expressed, that I have asked my correspondent for his kind permission to send extracts from them to Knowledge. Having received the permission, I append them below.—John Browning, Chairman of the London Tricycle Club.]

"I KNOW not what has been written *against* small wheels, but it must be very much to the point if it avails anything against your experience and statements proceeding from it."

"I agree with large wheels as contrasted with small *when the tyres are iron*, because the larger wheel has less curvature and larger bearing surface for that reason, and small iron-tyred wheels seem to require iron rails to run on. But rubber on the road is like the camel's spongy foot on sand and stones, it makes a level track, virtually for itself, virtually levelling stones and filling hollows, but this action must be in proportion to its bulk and softness and elasticity."

"The *rationale* of rubber seems to me to be thus fairly expressed:—It makes a wheel to serve as a foot. But in order to be so practically, its softness and elasticity must not be compromised by hardness proceeding from adulteration, and by reduction of its self-accommodating property by reduction of its bulk to the size of a walking-stick. Such sizes may do for a cinder-path, where grip and lightness are the sole requirements; but on a road where we require to keep an even course on a surface abounding in bumps and hollows, the good results of rubber depend on quantity and softness with abundance of elasticity."

"So far as the road is concerned, a large wheel is the nearest rigid substitute for a plane, and is really a clumsy contrivance, for it departs from the principle of a rigid circle and hard tangential plane for an approach to two planes. Whereas the rubber-tyre is a foot, not only accommodating itself to a true plane, when it finds one, but to irregularities also of all kinds within reasonable limits.

"Now this principle of the rubber-tyre is not affected by largeness or smallness of wheels within the limits of size which we use, and it is, therefore, wholly a mistake to go to the large wheels for that which the small one will yield as well. Nay, it will yield it better; for if we have tyres on small wheels containing as much (say) rubber as would be used in large ones, we shall have a great deal of elastic play of our small wheels, self-accommodation to irregularities of surface, and absence of jolting.

"I thank you for the number of Knowledge. I think your reasoning from facts quite conclusive.

"I am suffering from the very error you are writing against. I moved from a 16 in. to 24 in. steering-wheel without any corresponding benefit, but with the disadvantage of greatly-increased weight of framework to carry it."

"I mentioned to you a 'Meteor' sociable, which is let out at Beaconsfield, with small wheels and rubbers 1⅛ in. diameter. I heard to-day, by accident, that the tricycle in question is considered the easiest and smoothest travelling of any in Beaconsfield. This testimony is, in its way, as direct and positive as records of 50 or 100 miles would be. It may help your reasoning as being deduction from fact, if you can get information as to other

'Meteors,' or other tricycles which employ these large rubbers.

"While I am quite in accordance with you on the point of lightness, yet it must not be forgotten that anything which removes or neutralises obstructions makes a tricycle virtually light, therefore, even though the weight of a 42-in. wheel with large tyres and rubbers should be equal in weight to a 54-in. with $\frac{3}{4}$-in. rubbers, I should say that the smaller would be decidedly the better. Yet I am one with you in the matter of lightness. Momentum is the sum and substance of my travelling capabilities, and gravitation swallows it up insatiably, and obstructions expend it, and the less weight the less loss either on the hill or the rough road."

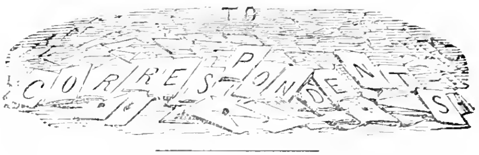
THE FACE OF THE SKY.

From Oct. 26 to Nov. 9.

By F.R.A.S.

The usual daily watch will be kept on the sun for spots, faculæ, &c. Map XI. of "The Stars in Their Seasons," shows the aspect of the night sky. Mercury is very badly placed for the observer during the last part of October, when he is a morning star, but may just possibly be caught with the naked eye before sunrise in the E.S.E., or near the horizon during the first week in November. Venus is about as badly placed for the observer as she can be. Mars rises between 10 and 11 p.m. during the last week in October, and a minute or two before 10 on the night of November 9. As his diameter still very little exceeds 9″, he needs a powerful telescope to see him properly. Jupiter rises about 10h. 12m. p.m. to-night, and, of course, sooner and sooner on each succeeding one until, on November 9, he will appear above the horizon about 9h. 21m. in the evening. He is situated to the W.S.W. of the "Præsepe" in Cancer ("The Stars in Their Seasons," Map III.) The phenomena of his satellites visible before 1 a.m. during the period covered by these notes are the group of Satellite II. from transit of his disc at 11h. 52m. p.m., on November 1, and the reappearance of Satellite III. from eclipse on the same night at 12h. 5m. 58s. p.m. Then, on November 6, Satellite I. will disappear in eclipse at 12h. 49m. 7s. p.m. On November 7, Satellite I. itself will enter on to Jupiter's face at 11h. 18m., to be followed by its shadow at 12h. 22m. p.m. The next night, that of the 8th, Satellite I. will reappear from occultation at 10h. 50m. p.m., and at 11h. 28m. p.m., Satellite II. will begin its transit. Its shadow will follow it at 11h. 47m. Lastly, at 12h. 46m. 14s. p.m., Satellite III. will disappear in eclipse. Saturn is nightly coming into a more favourable position for the observer, and about midnight presents a glorious spectacle in the telescope. He is still above Aldebaran or α Tauri ("The Stars in their Seasons," Map I.). Uranus is invisible, but Neptune is visible, as a little 7th mag. star, all night long to the S.E. of δ Arietis ("The Stars in their Seasons," Map XII.). The moon is 25·3 days old at noon to-day, and, of course, 29·3 days old at the same hour on October 30th. On the 31st her age at noon is 0·5 days, and by November 9th it will evidently be 9·5 days. Hence she will scarcely be observable before November 3rd at the earliest. No occultations of stars occur before midnight during the interval covered by these notes. The moon is in Leo up to about 10 a.m. to-morrow (the 27th), when she passes into Virgo; her passage across which constellation occupies until ten o'clock on the night of the 30th. At this latter hour she crosses into Libra, over which she travels during the whole of October 31st and until 10 p.m. on November 1st. Then she enters that narrow strip which runs up northward in Scorpio. She traverses this during the next eleven hours, and passes into the southern part of Ophiuchus. This she quits about 6 a.m. on November 4th for Sagittarius. Her journey across Sagittarius is not completed until 7 p.m. on November 6th, when she enters the upper part of Capricornus. At 1 p.m. on the 7th she passes thence into Aquarius, where, up to midnight on November 9th, she still remains.

The Ancient Monuments of Egypt.—The Society for the Protection of Ancient Buildings has recently issued its "Report on the measure adopted by the Government of his Highness the Khedive, for the preservation of monuments of Arab Art in Egypt." The report, which bears Mr. Thackeray Turner's signature, gives a succinct and interesting sketch of the measures which have been adopted for the preservation of these beautiful monuments since the date of the first Khedivial decree of Dec. 18, 1881.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE BARN OWL.

[968]—A part of Mr. Grant Allen's interesting article on the Barn Owl would give the impression that the owl is never guilty of feeding on young birds.

A gamekeeper of some experience held the same view until he shot one in the act of taking away a young pheasant from the coop. Where pheasants or partridges are reared by hand, the barn owl is a nightly visitant of the coops, clearing off any young birds that may have strayed from their foster-parents. If the owls once get a taste of the young birds, their visits will be as regular as the nights come round. It is, of course, natural that, as a bird of prey, it should take the readiest means in its power of supplying its wants. Kerry Rix.

PALÆOLITHIC MAN.

[969]—Enclosed please find extracts copied from Mr. W. B. Dawkins' "Early Man in Britain," and "Hunting-Grounds of the Old World," by H. A. L. ("The Old Shekarry"). In reading Mr. Dawkins' book I found the enclosed passages, and remembered the quoted passage from H. A. L.'s work, which I was reading a short time ago, and I wondered if it was within the bounds of possibility that the race or tribe mentioned by H. A. L. were descended from the Palæolithic Riverdrift men whom Mr. Dawkins mentions.

I do not suppose that any connection can be proved, but on turning to H. A. L.'s account of his introduction to this tribe, I thought the description he gives of them so like what one may suppose the Riverdrift men to have been, and the state of their civilisation and the arms used, allowing for the difference of situation, so similar, that I thought it worth while to copy the passages out and send them to you for your opinion. Myopia.

Extracts from "Early Man in Britain."

(Page 173, referring to Palæolithic Man in Britain.)

"We cannot refer them to any branch of the human race now alive, and they are as completely extinct among the peoples of India as among those of Europe."

Page 233:—"This difference in range implies, as we have already observed, that the Riverdrift men belong to the southern group of mammalia, while the cave men must be classified with the reindeer, &c." Again, on the same page:—"We are without a clue to the ethnology of the Riverdrift man, who, most probably, is as extinct at the present time as the woolly rhinoceros or the cave bear; but the discoveries of the last twenty years have tended to confirm the identification of the cave man with the Esquimos."

"Hunting Grounds of the World," by H. A. L., p. 99. (Description of two most extraordinary creatures in human shape.) One was old and wrinkled, the other quite a child, and both belonged to the weaker sex, but whether to the genus "man" or "monkey," I was not at all sure. They were of a dark olive colour, and the tallest was nothing like four feet high. She just was a beauty, without a stick of clothing, except a piece of creeper tied round her hair to keep it out of her eyes, which were small and very piercing when she opened them, but she kept them shut, just taking a peep now and then like a frightened ape. She grunted very hard, and I saw a couple of tears roll down her cheek as the gang tied her by the leg to the root of the tree. The nose was nearly flat, the mouth most

capacious and full of yellow teeth. The arms were long, attenuated, and wizened; the nails more resembled the claws of a vulture, both in colour and form, than anything else."

After stating how they used the elder of the two to induce some more of the same tribe to come to the camp, he goes on :—

"The men were but little over four feet high; all wore their hair tied with a piece of creeper at the back of the head, and spreading out like a peacock's tail. They had short bamboo bows, the strings of which were formed of the sinew of some animal, and the arrows were reeds hardened by fire, and tipped with quills of pea-fowls."

He then says these strange beings belonged to a race called Yanadi, and spoke in a harsh, guttural language.

ANTHROPOMETRY.

[970]—Mr. Grant Allen (in the *Pall Mall Gazette*) sums up the researches of the Anthropometric Committee of the British Association by teaching us that (broadly) the tallest men in Britain are found on the coast; and that this is a proof that these men are descended from other races than those inland. Is it safe to overlook another possible cause? Dr. A. Haviland first had the idea (more than ten years ago) of publishing Disease Charts of Great Britain. The first was of heart-disease; and it was shown that this is much less prevalent on the coast than inland. Now, other things being equal, a heart extra-nourished by fine sea-air should produce a finer physique all through—consequently greater stature.

"The very tallest men in the whole island are the Lowland Scots *of the sea-board*." Why are they taller than Lowland Scots inland, identical in race? I remember hearing (30 years ago) a Tipperary man boast that in the Militia of that county there was not one man under 6 ft. 3 in. Is it inhabited by a race different to that round about? Or is it not rather that the land of the "Golden Valley" has better fed her children? Hallyards.

RE JACK KETCH.

[971]—You write (Oct. 5, to E. D. Girdlestone), "but no soldier ever gets [misprint for 'yet.'—R. P.] enlisted with the thought that it would be a pleasant thing to him to take away life." I remember reading in a laudatory newspaper account of "Garibaldi's Englishman" (Colonel Peard), that he had joined with the *sole object* of killing as many men as possible, being a first-rate shot. He had no grudge against the Austrians, no care for Italian unity; he looked upon campaigning simply as so much man-stalking. I also remember regretting very much that I could not join the Austrians as a volunteer with the express mission of potting Colonel Peard, and so ridding my country of one disgrace at least. But as it is not probable he was unique, it seems as if a thirst for bloodshed is sometimes one motive for taking military service. Hallyards.

[No rule without an exception, but the exception proves the rule. Even here it was the shooting not the killing that was in question, though the disgrace to humanity is none the less on that account, *supposing* the newspaper report truthful.—R. P.]

DOUBLING OF POPULATION, CAPITAL, &c.

[972]—Let R = ratio of any increasing geometrical series, and r = increase per cent. per annum, or per term.

Then if $R^n = 2$

$$n = \frac{208 + r}{3r} \qquad \text{(A)}$$

$$r = \frac{208}{3n - 1} \qquad \text{(B)}$$

Example.

The annual increase of population in a certain town is 2·50645 per cent. Required the time in which the population will double itself?

$$R = 1·025065$$

By logs.

$$n = \frac{\log. 2}{\log. R} = \frac{3010300}{0107513} = 27·9994$$

By formula (A)

$$n = \frac{208 + 2·50645}{3 \times 2·50645} = \frac{210·50645}{7·51935} = 27·9953$$

The formula thus gives the exact answer to the second decimal place, the error being only $-$·0041, or 35 h. 54 min. in time, an error which might generally be neglected; but if great accuracy were desired, ·005 added to the answer would render it within $\frac{1}{·10000}$ of a unit of the result by logarithms.

Example 2.

The population of a town doubles in 27·9994 years. Required the annual increase per cent.

By logs.

$$\frac{0·3010300}{27·9994} = 0·0107513 = \text{log. of } 1·025065$$

$$1·025065 \times 100 - 100 = 2·5065.$$

By formula (B).

$$r = \frac{208}{27·9994 \times 3 - 1} = \frac{208}{82·9982} = 2·5061.$$

This formula gives the answer right to three places of decimals, the error being $-$·0004. The simplicity of these formulæ, which render them easy to recollect, combined with their great accuracy, render them valuable for many purposes, and more especially in cases where logarithm tables are inaccessible. T. J. B.

CURIOUS MULTIPLICATION.

[973]—Multiply 10,958,904 by 18,127,076; 15,068,493 by 34,605,731; 36,585 by 19,849; 615,384 by 34,521; 30,136,986 by 1,058,581; 68,493,150 by 13,260,896.

The peculiarity of the above examples is that in each case the product can be obtained by the following rule:—Multiply each figure of the multiplicand, beginning at the right, by its number in order, counting from the right, and set down the result in the corresponding place in the product, carrying where necessary, until you have multiplied the first or left-hand figure by the whole number of the figures. Then, begin again at the right, multiplying each figure by its number in order, counting the other way from the *second* figure, and ending with that second figure. For example, to multiply 36,585 by 19,849, set down 5.2 × 8, 3 × 5, 4 × 6, 5 × 3, 4 × 5, 3 × 8, 2 × 5, 6, carrying where the product is more than 9, which gives the answer 726,175,675. A. B.

FIGURE MAGIC.

[974]—The following variations of the familiar "Think of a number, double it," &c., may be of interest, and an explanation of the apparent mystery would be very acceptable to myself.

A. "Think of a number."
B. Thinks of, say, 373.
A. "Treble it. Is the result odd or even?"
B. "Odd."
A. "Add one, halve and treble, and say if result is odd or even."
B. "Even."
A. "Halve result, and say how many times 9 will divide the half."
B. "Nine will go 93 times into the remaining half."
A. "You thought of 373."

Now, A. has been told that the trebled result was odd and even, but numbers might have been thought of that would give us trebled results.

a. Even and even.
b. Even and odd.
c. Odd and even.
d. Odd and odd.

As procedure is to multiply the reply to the last question by four, and if the questions about odd and even have been replied to as *a*, *b*, *c*, or *d*, he adds 0, 2, 1, or 3 accordingly.

Thus B has thought of 373.

```
   373
     3
  ----
  1119   Result : odd.
     1
  ----
2)1120
  ----
   560
     3
  ----
2)1680   Result : even.
  ----
 9)840
  ----
    93
```

Now A multiplies 93 by 4, and having been told that the trebled results were odd and even, C adds one, which makes up 373, the number thought of by B. Inquirer.

PROPERTY OF NUMBERS.

[975]—If we take ·14 and double it and move the result two places from the decimal point so as to obtain ·0028, and similarly from this obtain ·000056, and so on, then the sum of all the numbers thus obtained will be $\frac{1}{7}$. The process may be exhibited thus:—

·14
28
56
112
224
448
896
1792
3584
7168
14336

·142857142857142857

The reason for this may be exhibited thus:—

Let $x = ·14 + ·0028 + ·000056 + \ldots$

$$\therefore x = \frac{14}{100} + \frac{28}{10000} + \frac{56}{1000000} + \frac{112}{100000000} + \&c.$$

$$\therefore \frac{2x}{100} = \frac{28}{10000} + \frac{56}{1000000} + \frac{112}{100000000} +$$

Subtracting, $\frac{98x}{100} = \frac{14}{100}$ $\therefore x = \frac{14}{98} = \frac{1}{7}$.

C. W. Bourne.

IS THE COMMON EARTHWORM LUMINOUS?

[976]—Having had my attention drawn last night (October 8) to some phosphorescent streaks on the road, which had been observed by some friends, I sallied forth with two of my pupils, and having found two streaks, struck some matches with which I had provided myself, and found that the phenomena proceeded from what were apparently two small earthworms. Is the common earthworm luminous, or is there a special light-giving variety?

They had not the slightest resemblance to glowworms, but were exactly similar, as I have said, to small earthworms.

J. J. C. Fenton.

LUMINOSITY IN PLANTS AND ANIMALS.

[977]—I am a constant reader of your paper, and have seen some correspondence lately on luminosity in plants. The other evening I noticed a "something shining in the dark," as Cowper puts it, and not having observed any glowworms in this part of the country, I procured a light to see from what this light was emanating, and found it was from an insect which I suppose is of the centipede family, and of the dimensions as follows:—

Can you please explain this in Knowledge, as I presume the animal is not luminous of itself. A substance like phosphorus fell from it as I viewed it on the damp earth. On bringing the creature into a room, and turning the gas very low, it was no longer luminous.

G. Herklats Vos, B.A., M.R.A.S.

ORGANIC MATTER IN METEORITE—HEAVY FALL IN BAROMETERS.

[978]—I observe in your number of the 31st ult. a note respecting a "Carbonaceous Meteorite."

It is distinctly in my mind that some time ago I saw in some scientific journal a statement that traces of organic life in the shape of an oyster-shell [!] had been discovered in a meteorite, and I think Sir W. Thomson's name was connected with the discovery.

You will have heard, ere this, I dare say, that during Saturday night all the barometers here—that is, the old-fashioned circular-faced ones—tumbled suddenly down, as to marking, below all the degrees very stormy at 28°. Had the one in my room gone on a little further he would have registered "Set Fair." I was told such a thing had never here been seen before. The storm blew from the south down the pass from Snowdon to-day; still continuing, it tears from the north up the pass.

B. H. M. Rocke.

THE STORM GLASS.

[979]—Would you kindly inform me whether the following recipe for the "Chemical Barometer," or "Storm Glass," usually sold in opticians, is correct?:

"Put into a tube $2\frac{1}{2}$ drachms camphor, and 11 drachms spirits of wine. When the camphor is dissolved, which it will readily do by agitation, add the following: Water, 9 drachms; nitrate of potash, 38 grains; muriate of ammonia, 38 grains. Dissolve in water, prior to mixing with the camphorated spirit, then shake the whole together. Cork the bottle well and wax top, but put a small hole in top; or, better, cover the top with skin. The above forms an excellent indicator of the changes in the weather."

I have made several glasses according to the above recipe, but they have all had a heavy white appearance, owing, I think, to the excess of camphor, very different from the fleecy-grey matter composing the optician's glass.

This thick, white matter solidifies, and does not change its position as it should. The opticians' storm glass is sealed at the top, with *no air-hole.*

I should be glad if any of your correspondents would kindly supply me with the proper recipe.

John H. Milne.

WART-CHARMING.

[980]—Allow me to tell you my own experience of warts. When I was a little boy I had a wart on the tip of my nose. They called me Cicero. My father's æsthetic taste was annoyed at this non-essential to the beautiful. He had recourse to the knife, and then stanched the blood with caustic. This process was equally unpleasant and unavailing. The cauterising was constantly renewed, but the blackened excrescence stubbornly remained rooted to my inflamed nose. Mr. Thomas, a Supervisor in the Excise, took special delight in teasing me whenever we met. "Master Frederick," he would say, "I think you have a fly on your nose;" or, "There is a spot of dirt," &c., &c. "Allow me to remove it." In the course of time I left home for a boarding-school, where the medical attendant gave me a powder with which to rub my wart. He also tied a piece of silk round another which grew on my eyelid. Both were gone in a few weeks. The holidays came, and one of my first visits was to my old tormentor, Mr. Thomas. He was out, but on my showing his wife that the wart was no longer to be seen, "Bless me!" said she. "Why, my husband has it!" And sure enough, when he came in a few minutes later, there was the wart on the tip of his nose. I told him how the doctor at school had cured the one on my eyelid, and he allowed me to tie a piece of fine strong catgut round his, in doing which I paid him off by giving such a sharp pull at the two ends that his eyes watered again as he howled and danced about the room. From time to time for some years the wart returned and disappeared. I always fancied that old Thomas had it when I lost it, and *vice versâ*. Whether it was so I cannot tell; all I can say is that his went and came at intervals in a similar way. This I heard from Mrs. Thomas some years later. I have met and known several successful wart-charmers. One told me that he had "charmed enough away to fill a bushel-basket." A very favourite charm in many parts of England was to bury a piece of meat secretly after touching the wart or warts with it. As the meat rotted in the ground so the wart died away. Years ago I tried charming children's warts myself, and found that they vanished within the time I promised.

Frederick Hillmore.

AUDITORY FANS (THE AUDIPHONE).

[981]—The teeth or any bones of the head may be utilised for conveying sound vibrations to the inner ear if the outer ear be closed, either mechanically or by disease. A deaf person wishing to know whether the Audiphone will be of service to him should try the effect of placing his watch between his teeth; or, taking a lead pencil in the same way, and pressing it against the window-frame, he should get some one in the room to speak to him. Other experiments will suggest themselves. I have used the Audiphone for years, and shall be happy to answer questions.

F. Hurley.

LETTERS RECEIVED AND SHORT ANSWERS.

G. Estall. My lectures at Kensington Town Hall will begin at eight o'clock. G. G., Harry H., M. B. Huskisson, Perry Parnham, Obliged, and others. Glad you like the lines; as to our admitting more, *cela depend*; those who prefer to have nothing but clear common sense in plain prose have a rather rough-and-ready, not to say rude way of expressing their opinion, and Vega's muse may object to "be treated unbenignly." H. B. Will forward to Vega your careful counting. It is too late to call on a few rather

eminent writers of blank verse to correct their metres. For instance how sad to think that a person called John Milton wrote two such lines as these:—

"Princes of Hell? for so the popular vote
Inclines here to continue, and build up here,"

&c. Now if "H. B.," had gone counting along after him Mr. Milton would have sat corrected. Then Shakespeare,—why, dear me, he (you may have heard of him perhaps?) was quite a gross offender against your blank verse rule. Here are a few lines for you to count over,—don't trouble to read them, still less think what they may mean,—keep on counting syllables, that's the only true way to enjoy poetry

"For not alone
The death of Fulvia with more earnest touches,
Do strongly speak to us; but the letters, too,
Of many our contriving friends in Rome
Petition us at home: Sextus Pompeius
Hath given the dare to Cæsar, and commands
The empire of the sea: our slippery people
Whose love is never link'd to the deserver,
(Till his deserts are past) begin to throw
Pompey the Great, and all his dignities,
Upon his son; who high in name and power,
Higher than both in blood and life, stands up
For the main soldier; whose quality, going on,
The sides o' the world may danger: much is breeding.
Which, like the courser's hair, hath yet but life,
And not a serpent's poison. Say our pleasure," &c.

You may perhaps have noticed also that the page of KNOWLEDGE on which the lines appear is not perfectly rectangular. I fancy Vega could give a tolerably good reason, though you might not perhaps be convinced by it, for dropping a syllable (to be replaced in reading I imagine by a pause—appropriate enough—after the word "dead") in the line

"And dead.—Their ruling sun shone on them," &c.

And even for the eight syllable line,—though the licence is unusual

"Till—sweeping onwards—shone its orb," &c.

It would have been so easy to have completed the ten syllables you think essential—but others do not—by throwing in the word "swiftly" before "sweeping" that—do you know?—I shall be not at all surprised to learn that Vega thought the change of measure, and the suggestion of pause, more effective. But pray do some more counting and give us some more rules. Should the number of words in a paragraph be odd or even, a perfect square or a perfect cube, prime or resolvable into factors? You might find time to glance over Macaulay's essay on Byron, to learn what he (Macaulay) thought of such rules—if you can give any attention to mere thoughts. J. HARRISON. Your comparison to Thomson will please V. No; V. is *not* Mr. Spurgeon.—MISS RYALL (Ventnor) should send such communications to the publishers, the Editor has nothing to do with the matter.—JAS. DIXON. Thanks for notes suggestions about American English, Mr. Foster's "Nursery Rhymes," &c. That sentence about Shakespeare's Salisbury should have run, "Shakespeare knew only trisyllabic Salisbury." "Well-natured" has as good a right to exist as "goodnatured." Every one who writes much is apt to make words to his use if he wants them: I know, *I* do—freely. Is not your criticism hypercritical that "the French" and not "we" have Guillaume, &c.? Are not the French of us? or does "we" always mean "we English"? If it is to be restricted, why not take it to mean "we Londoners"? or "we the tailors of Tooley-street"? or we the Fortescue-Montgomeries? or "my wife and I"? *Is* Hertford always called Harford, without the "t"? That cannot be right to a "t." I must show Mr. Foster your remarks, perfectly just, about Nursery Rhymes.—AUGUSTUS J. HARVEY. Fear publication of your letter would bring on us a shower of similar communications. HARRY.—That puzzle,

Sisters and brothers have I none
But that man's father is my father's son

must be a good one, since you say the majority of your friends think "that man" is the speaker himself: for *that* is not the answer. I remember the question was propounded over our desert at the captain's table on the Pacific S.S. *Australasia*, and in about five minutes every one had out card and pencil and was loudly maintaining his own particular view. Captain Cargill said at last, jokingly, that he would put in irons the first who resumed the subject: but it so chanced that had he carried out his threat Mrs. Cargill would have been manacled very unsuitably for a lady. I was offered a wager of five pounds that the man referred to was the speaker, and other wagers were offered round the table in favour of other solutions equally incorrect. But by the following morning the whole company (for the trouble spread to the whole saloon) had accepted the correct view. Such puzzles as these are useful mental exercises; though, of course, they involve no difficulty if reasoned straight out. Thus in the present case, we see from the first line that the speaker is an only child, and therefore his father's son can be no other than himself; so in the second line we may say "myself" instead of "my father's son,"—getting "That man's father is myself," a statement which is assuredly not very perplexing. "That man" is of course the speaker's son. Another puzzle was propounded the same afternoon by Mrs. Cargill on the *Australasia* which took in most of us:—A train starts daily from New York to San Francisco, and one daily from San Francisco to New York, the journey lasting seven days; in travelling from San Francisco to New York how many trains do you meet? Now I had made the journey, and had noticed the interval between the successive trains met: so I had no excuse for blundering. Yet did I incontinently blurt out the wrong answer, Seven, with the proviso that six or eight may be met if the train starts (1), just after or (2) just before, a train has arrived. The real answer of course is not *near* this.—F. W. WOOLER. Am unable to say: never reply on such matters by post. CHAS. E. BELL. Your solution implies that each of the 21 possible endings is equally probable. Is that so? There was never any question except on that point. Not knowing the game, I could not reply. Your solution of the chess problem is correct. What a pretty little problem is is: except that it suggests the thought, Lo! the poor Indian. Such solutions should be separately addressed to Chess Editor.—H. HUDSON. Regret that cannot find room for the suggested seven articles on Postage Stamps.—R. G. ARNOLD. You have not quite caught Mr. W. M. Williams's idea. Besides, the overwork and tasteless food do their work usually *before* recourse is had to strong drink. But you are quite right in saying that poor living alone (*i.e.*, without the use of alcohol) will not make a drunkard. People do not get drunk without first drinking. In that sense drink and not poor food is the chief cause of drunkenness.—C. E. You misconceive the way in which Parallax, or Goulbourn, or Rowbotham, or whatever his real name may be, is viewed by students of science. There was some interest in Hampden's case, in the evidence it gave as to the possibilities of human brain-weakness. His abuse even was but amusing, to those who knew that he really was in earnest in considering astronomers rogues, villains, scoundrels, and the rest of it. With Parallax the case is quite different. You tell me I have an entire misconception of his purposes. I beg to say that you are mistaken. I have seen and read his book, I have been at the pains (it was as far back as 1864) to verify all his references, filling up all his garbled extracts and tracing out every winding by which he justifies his assumed name, an apt name for a "dodger" (see Liddell and Scott). Seeing his cleverness I utterly refuse to believe that he believes the earth flat, and therefore I utterly decline to enter into any argument with him, or to have anything whatever to do with him. That you believe in him, as you evidently do, gives you the same sort of claim as Hampden to an answer about any arguments which may have misled you. If you can cite any properly-attested case of a light, mountain, hill, or the like, seen beyond the distance corresponding with the ascertained shape of the earth, I will examine the case, and show (as, if the case is really well attested, I undertake to do) that the observation is entirely consistent with "the laws and conditions which must of necessity exist if the earth is a globe of about 25,000 miles in circumference." I except, of course, such cases of visibility as have occasionally been noted through effects of mirage or the like; as when Dover Castle was seen above hills known to lie directly between it and the observer, and to be high enough usually to hide it. Abnormally-arranged atmospheric layers will at times do stranger things even than that, even showing objects upside down instead of the right way up. But doubtless the cases which perplex you are not of that kind. In fine, I am ready to answer *you*, or any one who has been deluded by Parallax, respecting any difficulty you may wish to submit to me. But I will enter into no argument with a man who has approved himself wanting in the qualities essential to fair and profitable controversy.—ÆON. You are right. It has not been actually proved that Uranus turns on its axis in a retrograde manner; but the belts of Uranus are visibly parallel to the plane of his satellites' revolution, and it may safely be inferred his rotation corresponds in direction with their revolution.—N. P. BETTS. Your theory about gravitation cannot appear in KNOWLEDGE, and *ought* not to appear in any scientific publication, being unsound. —A FRIENDLY WARNER. You "thank God that you wear the Blue Ribbon." If there were another coloured ribbon for good manners, you could not honestly wear it. Nor would you be entitled to a medal for good reasoning. Strange that while one feeling causes you to obtrude your avoidance of stimulants on the notice of the people you meet, another (as worthy, perhaps) causes you to conceal your identity from the person you strive to insult. Your case is interesting and typical.—NAGGDRIB. Many thanks for paragraph.—JOS. SWIFT. See answer last week about Reason why

statement. By taking a piece of flat glass of known thickness, and placing it on a suitable surface, you can test the matter very easily.—G. LAPTHORNE. You overlook the circumstances that the sun on the heavenly dome is apparently carried round by the earth's rotation. That is the sole cause of the apparent daily movement of the spots which you have noticed. By observing always at the same hour, or otherwise by making due correction for the effect of the diurnal rotation, you will see that the spots have the movement described in the books.—C. LONGHURST.—Impossible to answer such questions by post, or even—systematically—here.—Z. The idea of a sort of space-density as a fourth-dimension in space, is something you can talk about, but cannot possibly conceive. It by no means corresponds even with the fancies of the mathematicians of the inconceivable.—NEMO. The boat pushes in front of it a quantity of water which forms a slight elevation somewhat in front of the bows: this water is in effect withdrawn from the water round the ship's bows, so that the water surface naturally sinks a little at the shores just after the sort of ridge from the raised part in front of the bows has passed any point along the banks.—HALLYARDS. (1) Your first letter rather longer than can find space for. Moreover Plato's beautiful emblem of the den-images, or idols of the cave, is tolerably well known and understood. (2) *Are* the rills a primitive formation? The other letters marked for insertion.—H. C. MALDEN. (1) Yes, it is, as you say curious to think that the downfall of Linné must have taken place noiselessly. (2) The earth's attraction at the moon's distance is only a 600th part (roughly) of lunar gravity.—J. W. G. Comets shift about so, that you must really "say when."—J. J. C. FENTON. Letter marked for insertion.—ENQUIRER. Am entirely ignorant of the game of Baccarat; so is Five of Clubs.—R. S. WHITEHOUSE. Do not know if *Urocerus Gigas* has any stinging power.—MONTAGUE TROUP. Messrs. Cooke's address, York, or Southampton-street, Strand. Am unable to give useful answer about price.—J. H. PITMAN. Surely you do not consider cumbrous the methods by which in multiplying decimals, we omit all that will not affect digits to the right of the decimal place you wish to make your limit. I know very little of the text-book treatment of the subject, and in practice never do long multiplication sums; but if I had to multiply (for example) 12·3918 by 7·8263 correct to the fourth decimal place, should I not be acting absurdly if I began by multiplying 12·3918 right through by the right-hand 3, getting what I should know very well would add to my product only ·00371754 the last three digits on the right being manifestly useless. I should reason that as the 3 is in the fourth decimal place, to take account of more than one digit to the right of the decimal point in the multiplicand must be useless; so I should multiply as if the multiplicand were 12·4. Taking next the 6 I should multiply as if the multiplicand were 12·39. Then, for the 2, I should multiply 12·392, only taking the full multiplicand when I had reached the 8. The two forms of multiplication would run thus:—

```
     12·3918          12·3918
      7·8263           7·8263
     -------          -------
      371754              372
     743508              7431
    247836              24784
   991344              991344
  867426              867426
  ----------          -------
  969819434          969819
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The answer being given as 96·9819. I cannot see why the second and shorter process should be regarded as cumbrous. I suppose something akin to it is what Professor Henrici referred to. The only process I know of as contracted multiplication is that in which the multiplication is effected in one line; *this* process is undoubtedly cumbrous.—J. WARNER JONES. Thanks for letter, which shall appear as soon as space permits.

Our Whist Column.

BY "FIVE OF CLUBS."

AS the evenings grow longer Whist (the best of all card games) will be resumed. We have allowed it to retire a little from our columns, but it is by no means discarded. This in answer to the numerous players or would-be players of Whist among our readers, who have lamented its temporary absence. Those who are not Whist-players may no doubt wish that the space should be otherwise used. But they should consider the rest. To every one, *some* subject dealt with here must be of small interest, tastes vary so. But those who care not for Whist can easily pass over our column; those who play it know that it has claims, akin to those of Chess, to the character of a scientific game.

The editor of the *Australasian* Whist Column has courteously sent us copy of an article on our Whist in KNOWLEDGE, in which he deals with our earlier and recent treatment of certain Whist questions. He had been, he says, unsparingly severe in his criticism of our earlier papers and illustrative games, because we seemed to have sworn allegiance to the school of ultra-conventionists. Yet did he not altogether "abandon hope that the 'wooden-headed tomfoolery' of the 'petrolaters' would eventually cease to be expounded and advocated by Mr. Proctor's Whist editor." At last there came a game which "though chock full of conventional sequences," was devoid of interest except in showing that Mr. Proctor occasionally allows his wits to go a wool-gathering when he plays Whist. He calls this a ridiculous piece of principal-editor-worship—rather amusingly, considering that the game was specially contributed by Mr. Proctor as a simple illustration of the necessity of attention when a winning game is being played, the effects of his own carelessness being offered in evidence. If it is principal-editor-worship to point out the editor's blunders (even though at his own suggestion) what would principal-editor-correcting be? However we rose above that stage of ridiculous degradation in publishing three games annoted by Mr. Lewis, of which the *Australasian* justly remarks that they are "three of the finest examples of common sense and sound judgment in Whist play that have ever been put into type." Even here we erred by not mentioning that the games were originally published in the *Westminster Papers* some five years ago; but considering that we were not aware of the circumstance we hope to be forgiven. (Even if the games appeared in the *W. P.* the notes kindly written by Mr. Lewis had not before been published; and they were what gave chief value to the communication: there is no copyright in Whist games, which any one of four players may recall, to say nothing of bystanders.)

But the *Australasian* Whist editor takes now a kinder tone with us. He finds the six original articles on the management of trumps in the March and April numbers able and well arranged, the four first being especially worthy of the attention of his readers. We are glad of this, because it shows that in reality we take the same view of the conduct of Whist hands as our esteemed contemporary. The attention we directed to conventional rules was for the benefit chiefly of beginners. We are very far from thinking that Whist players should in a woodenheaded way follow a system of conventional play. But it is absolutely essential to success in Whist play that the meaning assigned now to certain leads, returns of the lead, signals, &c., should be known, that so the beginner may not play at a disadvantage, as he must if either he overlooks entirely indications whose meaning is obvious to the rest of the table, or by saying in Whist language what he by no means intends to say, deceives his partner and helps the adversaries. The illustrative games in KNOWLEDGE have been for the most part intended solely for beginners. But among them have been some, as in particular those contributed by Mr. Lewis, which illustrate the higher strategy of the game.

EXETER LITERARY SOCIETY.—Mr. R. A. Proctor delivered a lecture to a crowded meeting of the members of this Society at the Victoria Hall, Thursday, Oct. 18, on "Comets and Meteors." The Lord Bishop of the Diocese presided, and in his opening remarks his lordship observed that it gave him great pleasure to have the opportunity once more to introduce a lecturer whom many of them had heard before, and whom he was quite sure they would be glad to hear often. He had had the gratification of hearing Mr. Proctor before, and he had no hesitation in saying that he had never heard but one lecturer in all his life whom he should consider Mr. Proctor's equal. He had not had the pleasure of hearing Professor Tyndall, who had a very great reputation; therefore he could not make a comparison with him, but he had heard Faraday, who was certainly one of the very best lecturers that ever lived. Mr. Faraday was the only lecturer he ever knew whom he could say was really equal to Mr. Proctor. The lecture was listened to with the deepest attention, and at the close the Bishop moved a vote of thanks to Mr. Proctor. His lordship said that they would all carry away with them a complete idea of the subject, for never before had he heard it so explained. What they had heard would not soon pass away from their memories, nor could they fail to feel how such lectures as those enlarged their perception of the greatness of Nature, and of the Author of Nature. It was marvellous to find that all these material masses and complex systems were governed by one supreme law, and it raised them in the scale of being to be able to follow the hand of the great Creator in the works of creation. He hoped that Mr. Proctor would long maintain his health of body and clearness of mind to be able so to instruct his fellow-men.—*Plymouth and Exeter Gazette.*

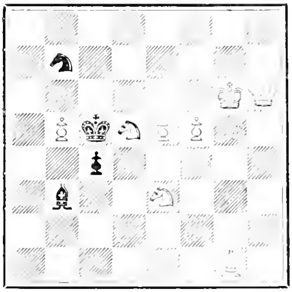
Our Chess Column.

By Mephisto.

PROBLEM TOURNAMENT OF THE *SOUTH AUSTRALIAN CHRONICLE* (ADELAIDE).

Best Three-mover (Hesperus), J. W. Abbott (London).

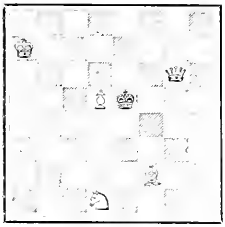
Black.



White.

First Prize "Set," 3 Mover. (Childe Harrold) W. J. McArthur.

Black.



White.

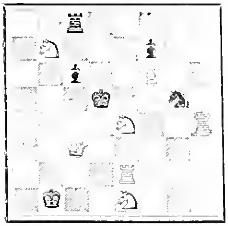
Second Prize "Set," 3 Mover. (Tendanda via est) L. Warneike.

Black.

White.

Best 2-mover. (Emu) A. Greenway.

Black.



White.

White to play and mate in 2.

First Prize "Set," 2-mover. (Childe Harrold) W. J. McArthur.

Black.

White.

White to play and mate in 2.

[p. 235.]—I have read with great interest your pointed remarks on the subject of the influence one mind can exert over another when playing Chess. Some two or three years back I met a gentleman over the Chess board, who, by a certain quiet, unconcerned manner of playing, and by a seemingly negligent way of making his moves, exercised a curious fascination over me. When contesting our first game, I felt a strange lack of power to exercise my usual foresight, an aimlessness of purpose in my moves, a passive indifference with regard to the result, which I had never experienced before. I made mistake after mistake, and wound up by a blunder which at once lost the game on my twentieth move. Several times after I met the same opponent and always with the same lassitude and carelessness of play, and also with the same result. Determined to alter this phenomenon, as he was acknowledged to be a weaker player in reality than myself, I sat down to the next game with him with a firm resolve to strain my utmost nerve to beat him. I struggled with the enervating influence that had hitherto bound me, and bringing my whole mind to bear upon the game, I at last broke the spell that enfeebled my play and came out a winner. From that moment I have had little trouble in defeating my formerly successful opponent, and have not once experienced a return of the fascination with which he deprived me of my usual powers.

Since that time I have made it a practice to watch carefully for any more examples of a similar kind, and I have detected several cases in which personal influence is distinctly traceable. A player of my acquaintance, highly nervous but generally outwardly composed, has only to meet an opponent of a stolid, slow temperament, who makes his moves with great deliberation and exhibits no token of interest in the game, than as the game progresses, he grows more and more agitated, his fingers twitch nervously, his pieces are moved with a curious indecision, and he almost invariably terminates the game unexpectedly by making a fatal error. His usual style is sharp, decisive, and telling, and the change can only be explained by assuming a strong personal influence on the part of his phlegmatic opponent. Although I could cite several more cases in which this strange power is evident, I must conclude by stating my firm belief that, in Chess at least, some minds exercise over other minds a strong fascination that materially affects the playing powers of the latter. Sis.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Clarence.—You are quite right in the Ending on p. 250. Mephisto won, playing with the black men, hence the slight mistake in annotation. Problem 102 is, I am sorry to say, faulty, for, in reply to Kt to B8, White can also play B to B7 besides B to Q8; therefore a plurality of duals would have to be remedied. Mr. P. is responsible.

E. F. B.—In Problem 101 if the R plays to Q4, the P can take the R.

F. Duplock.—Received with thanks.

A. A. B.—Game received with thanks.

Correct Solutions Received.—Problem No. 101, Maillind Neets. No. 102, John Watson, W., Berrow, Clarence.

Contents of No. 103

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOV. 2, 1883.

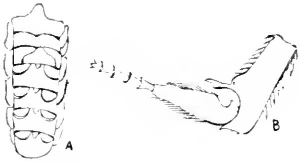
CONTENTS OF No. 105.

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

THE longest, and in some respects most beautiful tongue, found in any bee belongs to the genus *Anthophora* (Mason Bees). *A. retusa* makes its nest in sandy banks and crevices of walls, and its mouth-organs are beautifully displayed when mounted in a fluid medium. I obtained a fine specimen from Mr. Baker, prepared by F. Enock. It is obvious that the relation of bees to certain flowers must be affected by the length of their tongues, and in this respect the Mason has a great advantage. The Common Hive Bee cannot get at the nectar of flowers which the Mason and the Ligurian Honey Bee are able to reach. The American authorities praise the Italian bees highly. Thus, Professor Cook, in his "Manual of the Apiary," says:—"They possess longer tongues, and so can gather from flowers which are useless to the black bee. I have seen Italians working on red clover. I never saw a black bee thus employed." Darwin noticed that the Hive Bee was as fond of the honey of the red clover as the Humble Bee, and often saw it sucking it through the holes in the corolla bitten by the latter insect. He also stated he had been assured that when red clover had been mown, the flowers of the second crop were somewhat smaller, and these were abundantly visited by Hive Bees. "The fertility of the clover depends," as Darwin says, "on bees moving the petals, and if Humble Bees were to become rare it might be a great advantage to the clover to have a shorter or more deeply-divided corolla, so that Hive Bees should be induced to suck its flowers." As the Ligurian Bee is bred by some apiarists in this country, the Humble Bee may become a less important agent in fertilising this plant. The Italian Bee crosses with the Common Hive Bee, and perhaps some readers of KNOWLEDGE may have an opportunity of noticing whether the crossed variety possess the length of tongue belonging to the Italian race. This would be an interesting investigation, especially as Queen Bees have shorter tongues than workers, and so have drones. The mental characters of the common and of the Italian bee are reported to vary considerably. The latter are said to be more amicable to man, but fiercer to insect robbers who try to despoil them, and also to work earlier and later. Mr. Root, in his "A.B.C. of Bee-Culture," considers the hybrids equal in honey-gathering to the full-blood Italians, but he says "they inherit the boldness of the Italians and the vindictiveness of the blacks. Without any buzz or note of alarm, one of these sons of war will quietly dart forth and inflict his sting before you hardly know where it comes from; then another and another," &c. He also accuses them of being more disposed to rob than Italians, but not so much so as common bees.

A creature that leads so complex a life as a bee, has its habits determined by modifications of both external and internal organs. The Hive Bee requires wax, as well as honey, and this is produced by a special secretion. Mr. Root, in the work already cited, suggests a pretty experiment, that of feeding bees heavily on sugar syrup in warm weather, and at the end of the second or third day looking for the little pearly discs of wax that are newly-formed and protrude between the rings on the under side of the bee's body (A). He says they are objects of rare beauty under the microscope. The anterior legs of the bee are adapted



A.—Sketch of Bee's Abdomen, with wax plates protruding.
B.—Sketch of Bee's Fore-leg, with notch.

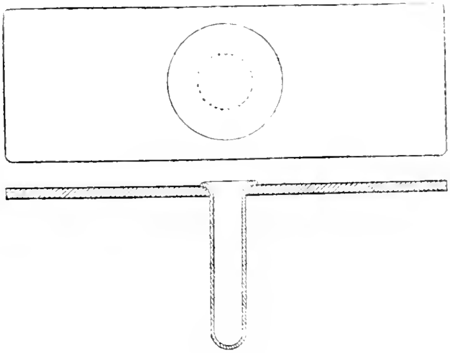
to seize these little wax cakes and convey them to its mouth, where it is kneaded with saliva.

To collect the pollen which is used in rearing the brood, the bee sweeps it from the plants with its tongue: its forelegs scrape it from the tongue. There is a little hollow in the leg, shown in the figure (B), and a finger-like projection opposite to it. Its tongue is said to be caught in the hollow, and when the leg is bent the projecting piece closes upon it. The pollen, moistened with honey and saliva, is conveyed by the middle legs to the hind pair, and stored in depressions somewhat miscalled "pollen baskets." They are little hollows easily seen with a hand-magnifier. Professor Cook speaks doubtfully about the function of the little notch in the foreleg of the working bee. He says, "For several years this has caused speculation among my students, and has attracted the attention of observing apiarists. Some have supposed that it aided bees in reaching deeper down tubular flowers, others that it was used in scraping off the pollen, and still others that it enabled the bees to hold on when clustering. The first two functions may belong to it, though other honey- and pollen-gathering bees do not possess it."

In the next paper the sting of the bee will be considered, as one of the modifications of an organ which has other shapes and uses in many insects belonging to the Hymenoptera.

To revert just now to another subject, the writer has been led to construct a tubular live-box, to facilitate showing the action of the blue-bottle's remarkable mouth-organs, and that of similar insects. It does not answer for bees. At this time of the year many large flies are driven indoors by the cold, and this little apparatus may assist in studying some of their interesting pecu-

liarities. When an ordinary live-box is used to hold a blow-fly captive, there is some difficulty in holding him tight enough, with the under side up, and yet



C.—Parts of Tubular Live-Box.

not so squeezed as to injure him, or interfere with his comfort. The tube live-box (C) is made with a small tube bottle, such as is used by homœopathic chemists, about an inch long and a quarter of an inch wide at the mouth. This is inserted into a hole cut in a wooden slide, and its rim prevents its falling through. Another wooden slide has a hole cut through it of rather larger diameter, and on the top side a thin glass cover is fastened with shellac glue. This slide is laid on the other. The glass cover forms a lid, which closes the tube bottle, and is held in its place by an elastic india-rubber band. A little cotton wool is put into the bottom of the tube to shorten the space, to suit the length of the fly, which must be inserted mouth uppermost, and kept moderately near the glass cover, upon which a drop of syrup is placed. Flies will readily feed in this position, and they are sufficiently limited in the power of lateral motion that they are easily kept in view with 1½ inch or inch objective.

STRANGE SEA CREATURES.

By Richard A. Proctor.

The Vicar of Bude reported recently the appearance of what he took to be some strange sea monster about a mile and a half from shore, near Bude Bay, travelling along at the rate of about twenty-five miles per hour (estimated). The object, whatever it was, was variously estimated at from 50 ft. to 80 ft. in length, which may be taken to mean that in all probability it was at least 30 ft. long. At one time a portion was so raised above the sea as to suggest that the monster was more like a serpent than a cetacean.

It is quite possible that the Vicar of Bude and those who with him saw this object were deceived by something which looked like a live sea creature, but was in reality not alive at all. In many ways such illusions have been produced. Some mass of floating seawrack, tossed by the waves into the semblance of life, may very well, at so great a distance as a mile and a half, have deceived the observers.

But it is well to notice that, although in numbers of cases objects taken for sea monsters have turned out to be inanimate masses, none of these interpretations of so-called sea-serpent stories can in the slightest degree negative the evidence obtained in such cases as that of the *Dædalus*, Government frigate, in which Captain McQuhae and his officers saw a sea creature unlike any known to science, travelling along against wind and sea, at the rate of twelve knots an hour, with the waves curling against its breast, and at a distance of less than 200 yards; so that, as Captain McQuhae puts it, a friend's countenance would have been recognisable at the distance. In several other cases the evidence has been equally decisive.

Then there have been other new sea creatures not at all like the supposed sea-serpent;—one, for instance, like a monster skate seen a few years back; another seen when the sea chanced to be exceptionally clear, crawling over the bottom of a bay on the Californian coast; and again, that singular sea monster seen in the Mediterranean a few years ago by the officers and crew of the *Osborne*, soon after a volcanic explosion had disturbed the sea bed there.

The fact really is that so far from the belief being absurd that creatures hitherto unknown exist in the depths of the sea, the wonder rather would be if men knew all, or even half, of the inhabitants of the ocean. It is astonishing how few of the denizens of the deep ever show themselves. In a sea journey lasting many weeks, one may see a shoal or two of porpoises, a whale or two, or the spouting of whales at a distance, a few sharks, flying-fish, and so forth, but not one in a million even of the sea creatures which during the voyage have been near the ship. For one sea creature which has occasion to come near the surface there are millions which never show themselves. I doubt if even half of the races of fish are known.

That there are marine creatures, also, other than fish, passing all their time beneath the sea surface, except when some occasional, and as it were accidental, circumstance may compel one of the race to come to the top, may be held to be absolutely certain. The doubts which have been flung on sea-serpent narratives, authenticated by responsible and reputable persons, are not scientific doubts, but the doubts of smatterers, who imagine that an air of doubt is an air of wisdom.

Quite probably none of the unfamiliar creatures taken for large serpents are serpentine at all. They may be long-necked creatures like the Dolichodeiros, or simply in some cases long backed creatures like the Plesiosaurus, or they may have been in some cases only very large ribbon-fish. But to confound well-authenticated accounts such as Captain McQuhae's and those given by the officers of the *Osborne*, with the taradiddles told for their own amusement (and half the time without any expectation that they will be believed) by Yankee salts, is to make an egregious blunder.

Vice-Admiral Coles goes a little further. Because a particularly illusory sea-serpent which deluded some seamen in the British Channel turned out to be a long line of soot, from the sweepings of a steamer's dirty flues, he thinks he has found the reason not only for the Rev. Mr. Highton's sea-serpent, but for the whole brood. The *Dædalus* in the South Atlantic was *very* likely to be in the track of steamers' soot-sweepings.—*Newcastle Weekly Chronicle.*

The large number of accidents occurring on American railways through carless crossing of the line, induces the *American Journal of Railway Appliances* (Sept. 15) to advocate prosecutions for recklessness, according to the English practice. It recommends that persons should be proceeded against for walking on the line, and jumping on and off trains in motion. Similar suggestions are made by other American papers.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XIX.

With the important exception of reference to the change effected in the Jewish doctrines of spirits, and its resulting influence on Christian theology, by the transformation of the mythical Ahriman of the old Persian religion into the archfiend Satan, but slight allusion has been made in these pages to the myths and legends of the Semitic race. Under this term, borrowed from the current belief in their descent from Shem, are included extant and extinct people, the Assyrians, Chaldeans or Babylonians, Phœnicians, Arabs, Syrians, Jews and Ethiopians.

The mythology of the Aryan nations has had the advantage of the most scholarly criticism, and the light which this has thrown upon the racial connection of peoples between whom all superficial likeness had long disappeared, as well as upon the early condition of their common ancestors, is of the greatest value as aid to our knowledge of the mode of man's intellectual and spiritual growth. And the comparisons made between the older and cruder forms underlying the elaborated myth and the myths of semi-barbarous races have supported conclusions concerning man's primitive state identical with those deduced from the material relics of the Ancient and Newer Stone Ages, namely, that the savage races of to-day represent not a degradation to which man has sunk, but a condition out of which all races above the savage have, through much tribulation, emerged. An important exception to this has, however, been claimed on behalf of at least one branch of the Semitic race—namely, the Hebrews or Jews. This claim has rested on their assumed selection by the Deity for a definite purpose in the ordering and directing of human affairs; a theory of the divine government which this journal is concerned neither to defend nor deny. No assumption of supernatural origin can screen documents of disputed authorship and uncertain meaning from the investigation applied to all ancient records; nor can the materials elude dissection because hitherto regarded as organic parts of revelation. The real difficulties are in the structure of the language and in the scantiness of the material as contrasted with the flexile and copious mythology of the Aryan race. And the investigation has been in some degree checked by the mistaken dicta of authorities such as M. Renan and the late Baron Bunsen; the former contending that "the Semites never had a mythology," and the latter (although any statement of his carries far less weight) that "it is the grand, momentous, and fortunate self-denial of Judaism to possess none."

But, independently of the refusal of the student of history to admit that exceptional place has been of direct Divine purpose accorded to any particular race, the discoveries of literatures much older than the Hebrew, and in which legends akin to those in the earlier books of the Old Testament are found, together with the proofs of historical connection between the peoples having these common legends, have given the refutation to the distinctive character of the Semitic race claimed by M. Renan. That a people dwelling for centuries, as the Hebrews did, in a land which was the common highway between the great nations of antiquity; a people subject to vicissitudes bringing them, as the pipkin between iron pots, into collision and subject relations to Egyptians, Persians, and other powerful folk, should remain uninfluenced in their intellectual speculations and religious beliefs, would indeed be a greater miracle than that which makes their literature inspired in every word and vowel-point. The remarkable collection of cuneiform inscriptions (so called from their wedge-like shape: Lat. *cuneus*, a wedge) on the baked clay cylinders and tablets of the vast libraries of Babylon and Nineveh, has brought out one striking fact, namely, that the Semitic civilisation, venerable as that is, was the product of, or at least, greatly influenced by, the culture of a non-Semitic people called the Akkadians, from a word meaning "highlanders." These more ancient dwellers in the Euphrates valley and uplands were not only non-Semitic, but non-Aryan, and probably racionally connected with the complex group of peoples embracing the Tatar-Mongolians, the distinguishing features of whose religion are Shamanistic, with belief in magic in its manifold forms. "In Babylonia, under the non-Semitic Akkadian rule, the dominant creed was the fetish worship, with all its ritual of magic and witchcraft; and when the Semites conquered the country, the old learning of the land became the property of the priests and astrologers, and the Akkadian language the Latin of the Empire."*

It was during the memorable period of the Exile that the historical records of the Jews underwent revision, and from that time dates the incorporation into them of legends and traditions which, invested with a purity and majesty distinctively Hebrew, were borrowed from the Babylonians, although primarily Akkadian. They are here, as elsewhere, the product of the childhood of the race, when it speculates and invents, framing its theory of the beginnings, their when and how; when it prattles of the Golden Age, which seems to lie behind, in the fond and not extinct delusion that "the old is better;" when it frames its fairy tales, weird or winsome, in explanation of the uncommon, the unknown, and the bewildering.

The Babylonian origin of the early biblical stories is now generally admitted, although the dogmas based upon certain of them still retard the acceptance of this result of modern inquiry in some quarters. That reluctance is suggestively illustrated in Dr. Wm. Smith's "Dictionary of the Bible," where, turning to the heading "Deluge," the reader is referred to "Flood" and thence to "Noah!"

So much for the legendary; but the analysis of the more strictly mythical, the names of culture-ancestors and heroes, sons of Anak and of God, scattered over the Pentateuch, is not so easy a matter. The most important work in this direction has been attempted by Dr. Goldziher,† but even his scholarship has failed to convince sympathetic readers that Abraham and Isaac are sun-myths, and that the twelve sons of Jacob are the zodiacal signs! Under the Professor's etymological solvent the personality of the patriarchs disappears, and the charming idylls and pastorals of old Eastern life become but phases of the sun and the weather. The Hebrew, like the Aryan myth-maker, speaks of the relations of day and night, of grey morning and sunrise, of red sunset and the darkness of night, as of love and union, or strife and pursuit, or gloomy desire and coy evasion. Abh-râm is the High or Heaven-Father (from *râm*, "to be high") with his numberless host of descendants. Yis-châk, commonly called Isaac, denotes "he who laughs," and so the Laughing one, whom the High Father intends to slay, is the smiling day or the smiling sunset, which gets the worst of the contest with the night sky and disappears. Sarah signifies princess, or the moon, the queen who rules over the great army glittering amidst the darkness. The expulsion of Hagar (derived from a root *hajara*, meaning "to fly," and yielding the word hijrâ or "flight," whence the Mohammadan Hegira) is the Semitic

* *Academy*, Nov. 17, 1877, p. 472.

† "Mythology among the Hebrews, and its Historical Development." (London: Longmans.) 1877.

variant of that inexhaustible theme of all mythology, the battle of Day and Night; Hagar flying before the inconstant sun and the jealous moon. And so on through the whole range of leading characters in Hebrew history; Cain and Abel, in which the critic overlooks the more likely explanation of the story as a quarrel between nomads and tillers of the soil; Jephthah, in which the sun-god kills at mid-day the dawn, his own offspring: Samson, or more correctly Shimshon, from the Hebrew word for sun, the incidents of whose life, as expounded by Professor Steinthal,* are more clearly typical of the labours of the sun; Jonah and the fish, a story long ago connected with the myth of Herakles and Hêsionê; "as on occasion of the storm the dragon or serpent swallows the sun, so when he sets he is swallowed by a mighty fish, waiting for him at the bottom of the sea. Then when he appears again on the horizon, he is spat out on the shore by the sea-monster."†

These bare references must suffice to show that there is in Hebrew literature a large body of material which must undergo the sifting and the criticism which has been applied with success to Indo-European and non-Aryan myth. This done, the Semitic race will contribute its share of evidence in support of those conditions under which it has been the main purpose of these papers to show that myth has its birth and growth.

THE HIMALAYAS AND THE ALPS.‡

PART II.

LOMBARDY and the valley of the Po, with the southern side of the Alps, presents somewhat similar physical features. A large area of about the size of the north-west Punjab, once a part of the miocene sea, is occupied by a remnant of rocks of that age, considerably elevated and tilted, but not to such an extent as those of the Himalayas. Near Turin these dip towards the mountains, and a very short examination shows the undoubted glacial character of some of the beds; and as the whole formation is marine, their large, sharply-angular material, much of which is jurassic limestone, was probably transported from the adjacent mountains by the agency of ice in a shallow sea. After the great crushing and alteration of the previous outlines of the whole country, another sea filled the basin of the Po, and pliocene deposits were laid down in a sinking area extending to the base of the mountains all round the new bay or gulf. Re-elevation again set in, and with it, or soon after it, the advent of another and the last glacial period.

But the bounds of the pliocene sea extended even farther than the base of the mountains. At the south end of the Lago d' Orta, well within the hills sheltering under the isolated porphyry hill of Buccione, and 280 feet above the present lake (or 1,500 feet above the sea), I discovered this summer a patch of pliocene sand and clays with marine shells in excellent preservation. A thickness of sixty-four feet of the section is exposed, capped by moraine matter; its base was not seen, and the beds dip north. This remnant tells us a good deal. From where it rests there is a clear horizon to the north down the lake to the junction of its river with the Toce—unmistakable evidence that these beds must have extended far in this northern direction, and that long, fiord-like arms of the sea stretched up as far as Domo d' Ossola on one side, and Bellinzona on the other. This marine bed is far above the level of the Lago Maggiore, but I also found marine shells of pleistocene age 112 ft. above that lake near Arona. Before the last great elevation of the Alpine chain, the old line of sea-coast, therefore, ran even high up the long deep valleys of Maggiore, Como, Garda, &c., during the early pliocene period; the mountains then, quite as high as now, enjoying a warm moist climate, not a glacial one. Then came the gradual but uneven elevation of the whole area, including the miocene hills south of the Po, and lacustrine and estuary conditions prevailed over much of the plain country. The lapse of time was probably enormous, and as the land rose and the sea retired the climate gradually became cooler, and ushered in the glacial period. I do not think it would be an exaggeration to add another 5,000 feet to the Alpine peaks of that time, which would give them an altitude equal to the Zaskar range of the north-west Himalayas of the present day.

With the change and the increased volume of the mountain torrents, the destruction of the upraised marine pliocene beds commenced, and finally culminated in the extreme extension of the glaciers even into the plains. They scoured out almost completely the whole of these deposits, which then filled the great valleys and the country at the base of the mountains, to redistribute them again over the plain of the Po, and silt up what remained there of the old estuary or gulf towards the east.

The denudation of this formation has been enormous along the base of the Alps, and only mere remnants are to be found. It is easily seen that their preservation is purely due to the accidental position in places where the great denuding force—viz, the advance of ice from the mountains—has been unable to touch them; in other instances the early deposition of moraine matter upon them has acted like a shield, and prevented their entire destruction. Such examples are well seen near Ivrea, in the well-known section in the gorge of the Chieusella near Stombinella, and in the moraine near San Giovanni.

The scattered remnants of the pliocene formation south of the Alps, which took perhaps thousands of years to lay down, show well how soon a great formation, together with the preserved remains of the fauna living at the time, may be completely destroyed by subsequent denuding forces. Similar destruction must have occurred over and over again in past geological ages, and shows clearly how the scanty broken record can be accounted for. It is an established fact that the great valleys of the Alps and Himalayas existed much in their present form during miocene times, and they may owe their excavation partly to the glacial action of that period, when these mountain slopes rose from the plain or margin of the ancient sea, far in front of the present line of slope, and were far higher than now.

Depression has steadily continued in the delta of the Po, as in the Ganges at Calcutta, for at Venice borings showed depression of land surface to an extent of 400 ft., and they did not reach the base of the formation. It is not improbable that during the earlier extension of the glaciers into the Maggiore basin, the sea still had access to it; this would have greatly aided in the removal of the marine deposits, and then the deeper erosion of its bed near the Borromean Islands, so well put forward by Sir Andrew Ramsey.

When we see the gigantic scouring which glaciers have effected in the hardest rocks on the sides and bottoms of valleys, when we know for certain the enormous thickness they reached in the Alps, I do not doubt their capability of deepening a rock basin very considerably, or their power to move forward over and against slopes so low as 2 deg. to 3 deg. The earliest extreme extension of the glaciers was

* "Goldziher," pp. 392, ff. † *Ib.* p. 103.

‡ From the address by Col. Godwin Austen, president of the Geological section, British Association.

very great; we have evidence of it on the miocene hills near Turin, their surface being scattered over with transported material of great size, quite unconnected with that other ancient period of glacial conditions during the miocene times mentioned above at a period too remote to further dwell upon here.

An enormous interval of time must have elapsed, during which the cold was increasing and the glaciers advancing, and during which the rivers were distributing the consequent waste over the lower country, spreading out the more or less coarse material, sands and clays, in broad fans in front of all the great gorges. Then came the first period of contraction of the glaciers, with many oscillations. Of this we have the evidence in the moraines of Ivrea, Maggiore, &c. Sections of these moraines show how they are piled the one upon the other; how the building up of one line of lateral moraine was followed by its partial destruction on another forward movement of the ice and the throwing down of another moraine upon it. Then were formed many of the smaller lakes, remains of which lie amid the *débris* thrown out into the plain.

The glaciers retained this size for a very considerable time, and then apparently very rapidly retreated to far within the mountains; but still for another considerable period their dimensions were much larger than those of the present time, into which they seem to have again rather rapidly shrunk.

In the Himalayas we find ample evidence of a period of great extension of such conditions—first, in the erratics of the Attock plain and the Potwar, lying 50 to 60 miles from the gorge of the Indus at Torbela. We have again the fact that in Baltistan, in the Indus valley, glaciers have twice descended far beyond their present limits, first down to Scardo itself, and then to some 30 miles below their present limits; while the glaciers of Nanga Purbet, towering above the Indus some 22,000 feet, must have descended into the bed of that river. Cataclysms of the present time, caused by glacial obstructions, have raised the level of the Indus on the plain above Attock so much as 80 feet. When these glaciers were more than double their present size, gigantic floods must have often taken place, and formed boulder deposits high above present levels; such high level gravels are to be seen not only in the Potwar, but also in the Naoshera Dhun on the Rajurie Tawi River, containing boulders of nummulitic limestone and other rocks on the Pir Punjal on the north. Again, north of the Chatadhar ridge, small glaciers, five to six miles in length, at one time filled the lateral valleys, descending towards the Chenab River to about 5,000 feet; and a very perfect moraine occurs in one valley.

Examples of the former extension of glaciers are widespread along the chain of the Himalayas from west to east. True moraines, and moraine-mounds, at 16,000 feet on the north side of the Baralasa Pass, attest the presence of glaciers on the elevated plain of Rukshu, where now the snow-line is over 20,000 feet.

Whatever may have been the length of the glacial period in the Alps—and it was very considerable—in the Himalayas it cannot have been so long and so general, although, to a certain extent, contemporaneous. In the Alps glaciation meets the eye on every side, and the mountains, up to a distinct level, owe their form and outline to its great and universal extension. In the Himalayas it is difficult to trace polished surfaces or striæ markings, even in the neighbourhood of the largest glaciers that are now advancing in full activity. It has been suggested that obliteration is the result of more powerful denudating forces, but the conditions are not so very dissimilar in the high Alps and high Himalayas as to warrant this; and wherever the oldest striæ marks occur in the Himalayas, they are situated near the bed of the valley. The Baltoro Glacier would extend, if placed in the Toce valley, from the Simplon to the margin of the Lago Maggiore; or, to take another illustration of its length, from Mont Blanc to Châtillon in the Valle d'Aosta.

Although of such great length, these Himalayan glaciers could never have reached the enormous thickness which the earlier Alpine glaciers attained. This may thus be accounted for: in the European area a generally low temperature prevailed down to the sea-level, while in the Himalayan it was local and confined to a higher level. It is evident that the snow-line has altered—higher at one period, lower at another—down to recent times, denoting changes of the mean annual temperature which are not yet fully understood, but have been attributed to very far distant distribution or alterations of land, sea, and the ocean currents. Two periods of glacial extension are clearly defined, separated by a milder interval of climate; during the earlier glacial period the Indus valley was filled with those extensive lacustrine and fluviatile deposits, mixed with the large angular *débris*, such as we see at Scardo, which may be coeval with the extreme extension of the Alpine erratics so far as the miocene hills south of Turin. The second period followed, after a long interval of denudation of the same beds, and would correspond with the last extension of the great moraines of Ivrea, Maggiore, Como, &c., followed by a final retreat to nearly present smaller dimensions.

Nowhere on the south face of the Himalayas do we find valleys presenting any features similar to those of the Southern Alps, particularly on the Italian lakes, which are the result in the first place of marine denudation, succeeded by that of depression, and finally powerful ice-action. On the south face of the Khasi and Jaintia Hills, however, which are orographically connected with the peninsula of India—the conditions altogether different—we find long stretches of water of considerable breadth and depth extending within the hills, and not unlike in miniature the Italian lakes. These valleys, worn out of the sandstone and limestone rock, have been formed here, to some extent by the aid of marine action and the subsequent depression along this line of hills, also marked here, as in the Western Bhutan Doars, by the absence of beds newer than the nummulitic.

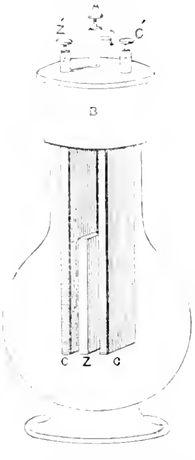
THE AMATEUR ELECTRICIAN.

BATTERIES. V.

"PUZZLED" writes to say that he cannot understand the theory which asserts that in the simple cell (zinc and copper immersed in water) the hydrogen, freed by the combination of the zinc with the oxygen of the contiguous water molecules, deprives the next molecules of their hydrogen, and associates itself with their oxygen, and that a series of such exchanges takes place until the copper is reached. He wants to know why one molecule or pair of atoms of hydrogen should break up a molecule of water simply to replace the hydrogen originally pertaining to it. This is truly a ticklish problem to many. It has, I suppose, puzzled more or less every one who has given any attention to the subject, to a greater or less extent. The theory generally accepted is that hydrogen in its nascent condition (that is, at the moment when it is freed from combination) is more potent, that is more electro positive, than that hydrogen which is already in a state of combination, and that it is on this account able to displace it. A rough and perhaps a somewhat inconclusive method of demonstrating that the hydrogen freed at the surface of the

zinc is not transferred to the copper is to place a narrow cell in a lantern and send a powerful beam of electric or other light through it. Vigorous action will be seen on the zinc and copper surfaces, but between the plates all is quiet. There is no visible rush of hydrogen bubbles through the water. Electro-chemistry abounds with illustrations of this nature. There is an excellent one, for which we are indebted to the ingenuity of Davy. Three small glass vessels, such as watch-glasses, are filled with pure water, solution of syrup of violets, and sulphate of potash respectively. The centre one, containing the violet solution, is connected to the others by means of moistened asbestos or other threads. The positive pole of a battery is placed in the water, and the negative pole in the sulphate of potash. In a short time the water will become very sensibly acid. This acid must have resulted from the action upon the sulphate of potash. Furthermore, it cannot have passed through the violet solution in a free state, otherwise the colour would (in the ordinary way of chemical reaction), have been changed to red.

Bichromate batteries, to which we now direct our attention, or those in which bichromate of potash is used, are a very efficient and comparatively economical class. They are, perhaps, more closely allied to the Bunsen than to either of the other typical batteries. Zinc in all cases constitutes the positive, and carbon the negative element. The earliest forms were single-fluid batteries—that is to say, they had only one



solution in which both the plates were immersed. Fig. 1 represents a form known on account of its shape as the "Bottle" bichromate. It consists of a long and wide-necked bottle, with a brass collar, B, into which an ebonite cover, E, is fitted. A brass rod, A, passing through a hole in the cover carries a zinc plate, Z, which can by this arrangement be lifted out of the solution when the current is not required. The loss of zinc by local action is thus in a great measure prevented. Two carbon plates, CC, are fixed to the cover, one on each side of the zinc, and are connected by means of a brass strap on the ebonite, so as to form practically one negative plate so arranged as to call into use both surfaces of the zinc plate. Z' is a terminal connected by means of a short brass strap with the small collar through which the rod A slides. C' is a terminal connected to the strap joining the two carbon plates. Small insulating studs attached to the zinc prevent its making contact with the carbons, an eventuality which would obviously short-circuit the cell. The solution consists of bichromate of potash ($K_2Cr_2O_7$) and water, acidulated with sulphuric acid (H_2SO_4). The solution should be a saturated one—that is, it should contain as much bichromate as it possibly can. It is best in preparing the solution to apply heat, as the water then takes up an increased proportion of the salt. A pint of water will dissolve about three ounces of bichromate. When cool, four ounces of sulphuric acid should be added, and when the current becomes weak a further addition of four ounces of the acid will restore it. This latter remark, however, applies only to single fluid cells.

The action is somewhat complicated, and is furthermore accompanied by energetic local action. The zinc acting with sulphuric acid forms the customary sulphate of zinc ($ZnSO_4$), hydrogen being released. The bichromate of potash acting with other portions of sulphuric acid produces chrome alum ($2KCr2SO_4$), water (OH_2), and free oxygen. The free or nascent hydrogen combines with the free oxygen and forms water, thereby preventing to some extent the polarisation of the plates. The action may be represented by equations thus—

$$\left.\begin{array}{l}3Zn+3H_2SO_4=3ZnSO_4+3H_2\\ K_2Cr_2O_7+4H_2SO_4=2KCr2SO_4+4OH_2+3O\end{array}\right\}3OH_2$$

Or putting the two actions into one line we get—

$$3Zn+7H_2SO_4+K_2Cr_2O_7=3ZnSO_4+2KCr2SO_4+7OH_2$$

It will be seen by these equations that for every three atoms of zinc dissolved, and 7 molecules of sulphuric acid reduced, only I molecule of bichromate is affected. This is fortunate, on account of the comparatively weak solubility of the salt. The chrome alum forms with water, crystals of a violet tinge and of great beauty. They are, however, unwelcome guests, as they form chiefly upon the carbons and the containing cell, and considerably impair the cell's efficiency. Their formation, too, proceeds when the battery is lying idle. One of the prettiest objects throughout the range of battery products is a carbon plate covered with chrome alum crystals. When held up to the light, so as to allow the rays to pass through them, their beauty becomes at once apparent.

Very frequently the cells are made with several plates of carbon and zinc alternating, the carbons being connected to one terminal, and the zincs to another. This, of course, is equivalent to employing a large plate of zinc opposed to a large one of carbon. More of this, however, in our next article.

The battery is for some purposes very useful. It yields an electro-motive force of 2·0 to 2·12 volts, and is therefore in this respect more powerful than the Bunsen or Grove cells. Its resistance, too, is naturally very low, being but the fraction of an Ohm. It, however, very speedily loses its power, and the current dwindles away to nothing. Raising and lowering the zinc once or twice overcomes this defect for a time, and in experiments we have been able to obtain satisfactory currents, by adopting this device, for hours together, while one charging has sufficed to supply a current three hours a day, twice or thrice a week, for six months or more. It is apparent, however, that the longevity of a cell is limited by the consumption of its constituents. The bichromate cell is, nevertheless, very serviceable where strong currents are required for short intervals, and where the nitrous fumes arising from the Grove and Bunsen are objectionable. Upon this point we shall have a few words to say when speaking of the practical application of the bichromate in the form of the Fuller cell, of which, by-the-way, several thousands are at present in use.

CURIOSITIES OF THE SUB-TROPICAL GARDEN.

By Geo. G. Chisholm, M.A., B.Sc.

FEW more welcome additions have been made in recent years to the ornaments of our parks than those plants derived from sub-tropical regions which are now generally to be seen in greater or less abundance during that part of the year in which our climate permits of their flourishing. These sub-tropical additions are not always more splendid than the natives of our own islands or of other temperate climes, but they at least add variety and novelty to the aspect of our parks and gardens, and very frequently they strike us by the marked contrast of their forms when compared with those with which we are more familiar.

But our observation of these strangers from warmer latitudes is enriched with a deeper and wider interest when we do not content ourselves with looking at what any visitor may see from the walks, but take the trouble to know something about what strikes our eye. What are the uses, we may ask, of some handsome plant which we cannot help admiring? Where does it grow? Is it of any peculiar scientific interest? Has it any value in the arts, or does it yield anything to commerce? It will, no doubt, be worth while to answer a few such questions that may be put, let us suppose, by a visitor to the sub-tropical gardens of Battersea Park.

In those gardens, as in any similar gardens, at the present time there is one sub-tropical plant which is almost sure to attract our notice among the very first—the plant known to botanists as *Carma indica*, and often popularly termed Indian shot, from the appearance of its seeds. It will be seen in large beds, which can be distinguished even at a distance by the tall spikes of sometimes scarlet sometimes yellow flowers. On a nearer view one admires the plant not only on account of its handsome flowers, but also for their beautiful foliage, their large, elliptical, glossy leaves, with numerous parallel veins running on each side from the midrib.

From a scientific point of view, this plant is of no little interest, by reason of the peculiar structure of its flower. This flower has within the whorl of true petals another whirl of petaloid organs, which, from their mode of development, are shown to be modified stamens, or rather stamens which have not developed into their normal form, and have consequently remained barren. Within that again another whorl is represented only by a single fully developed organ, one-half of which at the top is in the form of an anther, while the remainder is petaloid. Usually this is stated to be a stamen, in which the filament and one anther cell have assumed a petaloid character, but it seems to have been shown by Dr. Dickie that it is in reality a stamen bearing a two-celled anther as usual, but united along its whole length to another petaloid anther.

On either view this flower is scientifically interesting as presenting an example of the assumption by one part of a flower of the form proper to another. Such changes are by no means uncommon in the vegetable world, and it was phenomena of this kind that first drew attention to the essential unity of type that characterises leaves, sepals, petals, stamens, carpels, and other parts of a plant. It was such phenomena to which Goethe pointed in his celebrated little treatise on the Metamorphoses of Plants, in which, it may be mentioned, the case of Carma is referred to.

If we turn to another part of the garden we may see another plant, which is not indeed sub-tropical, but which is interesting because it illustrates the same transition as Carma. Floating on the surface of the little lake which adorns the park, the blossoms of the white water-lily can hardly escape the notice of any visitor, and in these blossoms the passage from petal to stamen is shown in the most unmistakable manner. The parts of the flower in this case are arranged in a spiral round the summit of the axis, and the first appearance of a stamen is in the form of a minute portion of an anther pinching the top of a petal. Gradually as we pass inwards we find the antheriferous portion becoming larger while the petaloid portion becomes more and more narrowed, till at last in the inner turns of the spiral we find the change complete. The petals have got narrowed to the form of ordinary filaments which are surmounted by long anthers. The flower has typical petals and typical stamens, but it is impossible to say where the petals and stamens begin.

Let us look before leaving at another remarkable ornament of the gardens. In this case it is a tree, and the most striking thing about it is its large, pendulous, somewhat trumpet-shaped white blossoms, blossoms sometimes reaching twelve inches in length, though not in this country. This tree is one of those which are unfortunately known even to men of science by more than one name. Formerly it was called *Datura arborea*, a name still retained by many, and this name shows that it is a close ally of the thorn apple (*Datura stramonium*), which the old botanist Gerarde introduced into this country, where it now grows wild in many parts. It differs, however, from the thorn-apple not only in the arboreal habit to which it owes its specific name, but also in wanting those spines on the fruit which have earned for the British Datura its popular designation, and likewise in having that fruit only two-celled, whereas the Daturas proper have the fruit more or less completely divided into four cells or compartments. These differences have induced some botanists to refer this tree to a separate genus, to which they give the name of *Brugmansia*, which is again an unfortunate circumstance, inasmuch as that same name is applied by other botanists to another genus as different from that of which we are speaking as any genus of flowering plants could well be. Our Brugmansia, it should be mentioned, is a member of the potato family, and like the potato is a native of South America.

Amongst other interesting cases recently recorded of the good services rendered by the Westinghouse brake two in particular may be mentioned. On the 11th ult. an express train from Hull to Leeds, on the North-Eastern Railway, when running over fifty miles an hour was turned off the main line into a branch at Crossgates, near Leeds, by a blundering signalman. The brake was at once applied, and the train was coming to a stand, when in taking another pair of points it was thrown off the line, and separated into two or three portions; but, thanks to the automatic nature of the brake, each was separately stopped and no one was injured. The other case comes from the United States, and happened on the Baltimore and Ohio Railway. The *Chicago Tribune* says:—"Yesterday morning at the dawn of day, when the express, which is due in Chicago at 5.40 a.m., was about thirty odd miles from the city, and running at great speed, the engineer noticed smoke in front of him, and feeling a presentiment of danger, instantly applied the air brakes and stopped the train, loaded with its sleeping freight, just in time to keep it from plunging into the Little Calumet River. The bridge was burnt, and not over 30 ft. separated the locomotive of the train from the yawning abyss." The simplicity claimed for certain brakes would prove but a poor substitute for the quickness and certainty of the automatic brake in such cases as the above.

THE GREEN SUN IN INDIA.

By Richard A. Proctor.

FURTHER letters from Ceylon show that the green or blue sun was only seen there (at least as a marked phenomenon) from the 9th to the 12th September inclusive. The *Ceylon Observer* contains some interesting communications on the subject. One correspondent, writing on September 12 from Puleadierakam, states that no light came from the sun, though he was visible, until nearly seven in the morning. "For the last four days," he says, "the sun rises in splendid green when visible—that is, about 10 deg. from the horizon. As he advances he assumes a beautiful blue, and as he comes further on he looks like a brilliant blue, resembling burning sulphur. When about 45 deg. high it is not possible to look at the sun with the naked eye; but, even when at the very zenith" (meaning, no doubt, the highest point of his path, *near*, but not absolutely *at*, the zenith) "the light is blue, vaiying from a pale blue early to a bright blue later on, almost similar to moonlight even at mid-day. Then as he declines the sun assumes the same changes, but *vice versâ*. The heat is greatly modified, and there is nothing like the usual hot days of September. The moon, now visible in the afternoon, looks also tinged with blue after sunset, and as she declines assumes a most fiery colour 30 deg. from the zenith." It is rather singular that the moon when nearing the horizon should have assumed a fiery hue, while the sun, when in the same position, looked blue. This seems to show that though the moon looks white, there is really a certain degree of ruddiness in her surface tints.

As to the explanation of the changed tint of the sun, a few points are clear. It is obvious that the absorptive medium whose action gave to the sun its bluish-green tint was in our own atmosphere, not in the sun himself. As the sun was seen blue at Trinidad on September 2, it seems probable that the Java earthquake had nothing, or little, to do with the sun's peculiar tint in India and Ceylon; for the blue sun of Trinidad cannot possibly have been caused by the Java disturbance. The spectroscopic evidence seems to show that the greenness of the sun was due to an exceptional development of the rainband in the red part of the spectrum (the exact position of the band is shown in a diagram illustrating an article by Mr. J. Browning in Knowledge (No. 102, p. 230). Thus was occasioned an abnormal absorption of red and orange-red rays, leaving a superabundance of rays from the rest of the spectrum, and, consequently, a tint of green.

It is noteworthy that an explanation advanced in *Nature* (whose editor is supposed to know something about spectrum analysis) by Mr. W. R. Manley, principal of the High School of Madras, is entirely incorrect. He finds in the circumstance that the colour of the sum varied after the order of the colours of the solar spectrum, evidence that there was some refracting medium in the atmosphere which resolved the sun's rays into primary colours. This would not account for the sun appearing green. There is no sort of prism which will show the sun green, or blue, or red, let the refracting quality of the medium be what it may. Seen through any prism whatever the sun would simply show rainbow-tinted fringes on opposite sides of a central and not quite circular white disc. Absorption was manifestly the cause of the sun's colour, not simply refraction—though refraction, of course, took place (as it always does).

A correspondent calls attention to the circumstance that in the Arctic regions the sun often shines with a pure emerald-green tint all through the day.—*Newcastle Weekly Chronicle.*

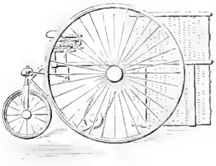
TRICYCLES IN 1883.

By John Browning,

Chairman of the London Tricycle Club.

THE "Carrier" just introduced by Messrs. Singer & Co. bids fair to bring the tricycle into still more general use in the business of everyday life. It is of very novel construction. Though a hind-steerer, it is a double-driver, both wheels working with one chain and a balance-gearing. The sides of the hay-fork frame are carried forward in front of the rider, and between them is suspended a large square wicker basket of a capacity of from forty to fifty cubic feet. The machine is contrived so that no more weight is thrown on the hind steering-wheel than is just necessary to ensure good steering.

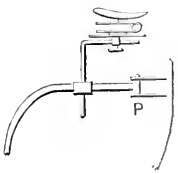
Evidently such a tricycle could be used with advantage instead of a horse and cart, to send out newspapers in bulk to the trade, or for the delivery of a number of light parcels. In country districts it would probably be serviceable to the Parcels Post.



The "Carrier."

The machine has wheels from 46 in. to 48 in. diameter, geared down to about 36 in. The value of such a machine would be increased tenfold if it were provided with a good two-speed gearing. The wheels should be 40 in., geared to run level. As it it necessarily a somewhat heavy machine, and will mostly be used in places of considerable traffic, it would not be required to be driven at a high rate of speed. The power-gearing should run at about 25 in. to enable the rider to work with a heavy load over muddy or rough roads, up hills, or against a high wind.

As the machine is now made I have driven it with great ease carrying between 160 lb. and 170 lb. in the basket on level ground.



The "Traveller."

The "Traveller" tricycle, brought out by the same firm, does not possess the same amount of novelty as the "Carrier," but it may prove of considerable value as a fast machine. It is a modification of the well-known "Humber," but the alterations are neither few nor unimportant. The double-driving-gear is reduced to about the size of a small tin blacking-box, being only about half the length of that on the usual "Humber." The pivots on which the front wheels swivel in steering (marked P on the block) are arranged in the form of a Stanley head, and are brought some distance behind the handle-bar towards the saddle of the rider. This, it is stated, diminishes the great

sensitiveness in steering so often complained of in the "Humber."

The saddle can be raised or lowered by means of an angle (┌─) seat-rod, which passes through the backbone; and the height of the handle-bar is also adjustable. These additions enable a man of any height to ride the same machine.

As far as I have been able to test the machine, I like it very much. Before long I hope to give it an extended trial over rough roads and up and down steep hills, and if I get satisfactory results I will report on them.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

By Richard A. Proctor.

(*Continued from page 147.*)

I AM sorry that pressure of space has compelled me to defer so long the concluding papers of the present series, especially as many readers have expressed a strong wish that there should be no interruption. But it seemed only fair to my fellow-workers here to remember that at first these papers appeared on successive weeks, and that therefore this was the series to give way, when pressure came, and not those which are appearing fortnightly.

Only two points remain now to be considered, one an apparent difficulty, and the other a strange illustration of the earth's rotundity, which I noticed several years ago when travelling by rail over the plains of Western America.

The appearance which the earth presents when seen from a balloon is peculiar, and at a first view suggests anything but the idea of a convex surface such as a globe like the earth might be expected to present. The earth beneath the balloonist appears in fact like a gigantic basin, the rim of which is the horizon all round him, while its deepest part lies below him. Mr. Glaisher (I refer to the eminent meteorologist and aeronaut, not his logarithmic offspring, the Glaisher of Prime Factors, to whom the expansion of logarithms—Characteristic One—is of more interest than that of any balloon the world has yet seen) has spoken of this illusion, though of course he was in no sense deceived by it.*

Fig. 18 illustrates the peculiar effect in question; but I have added to the illusion affecting the aspect of the earth's surface another, equally marked and much more familiar, affecting the aspect of the clouds.

The explanation of both peculiarities is the same.

In my papers on Clouds and their Appearance I have shown how we are deceived into the idea that the clouds form a sort of dome over our heads, whereas the under surface of a layer of clouds, though slightly arched, is in reality very nearly flat within the range of view commanded by the eye. The eye is not sensible of the much greater distance separating us from the clouds near the horizon than from those overhead; and losing the effect of distance we picture the cloud-surface near the horizon as springing almost if not quite vertically from the earth's surface, to arch over, gradually at first and more rapidly afterwards, towards the point overhead. When we view the under surface of clouds from a balloon situated as shown in Fig. 18, a similar effect is produced.

But also, and for precisely similar reasons, a similar effect is produced on the appearance of the earth's surface below us. When we look directly down we see that the earth lies far below us, the greatness of the distance being very obvious and striking. On the other hand when we look towards the horizon, although the line of sight really is depressed slightly below the horizontal direction, the depression is not at all obvious, even when we are a mile or two above the sea-level.

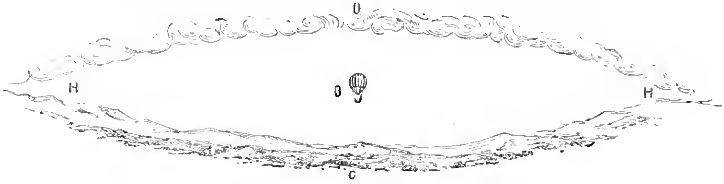


Fig. 18.

Say for instance we are even so much as two miles above the sea-level. Then from what has been already shown, the depression of the visual horizon (suppose it to be a sea horizon) below the true horizontal direction, corresponds to the angle subtended by four miles at the distance where the line of sight from a height of 2 miles touches the sea level. This distance, neglecting refraction, which really increases it,* is represented in miles by $\sqrt{2 \times 8000}$, or by $\sqrt{16000}$, or by about 127 miles, and 4 miles at a distance of 127 miles subtends less than 2 degrees, which to the eye appears but an insignificant angle. Comparing unconsciously this slight depression of the horizon, with the obvious and startling depression of the earth's surface underneath his car, the aeronaut is deceived into the impression that the surface underneath rises up all around him to his own level or nearly so,—in other words the illusion of a basin-shaped depression such as is shown in Fig. 18 is produced.

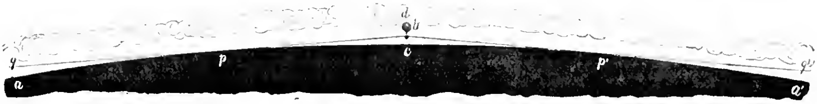


Fig. 19.

* But the crafty Parallax, by quoting in his Zetetic Astronomy Mr. Glaisher's account of the illusion, without the sequent comments, cleverly leaves his readers, if he has any, to suppose that Mr. Glaisher thinks the earth may have a concave surface,—so that as the astronomer holds the earth to be convex while the aeronaut—thus misrepresented—holds it to be concave, the flat-earth folk feel justified in striking a happy mean and considering it to be as flat as flat may be.

* Taking it into account would strengthen the argument.

The real state of things is represented, only the earth's curvature is necessarily monstrously exaggerated, in Fig. 19, where b is the position of the balloon, $a\ c\ a'$ the earth's surface, c immediately below the balloon, $q\ d\ q'$ a layer of clouds parallel to the earth's surface. The lines $q\ p\ b$ and $b\ p'\ q'$ are tangent lines to the earth's surface, which they meet in the points p and p', while they meet the layer of clouds in q and q'.

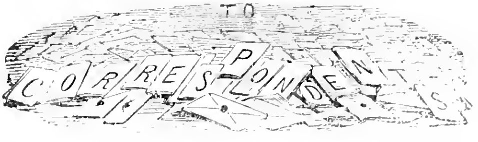
(*To be continued.*)

MUNIFICENT EMPLOYERS.

EIGHTEEN months have now passed since the great firm of Tangye Brothers was converted into Tangyes (Limited). The brothers Tangye still hold nine-tenths of the business, and the other gentlemen who had joined the firm had, with a single exception, been associated with Messrs. Tangye in the management of the business for many years before they became partners. The first annual meeting of the company was held at the Cornwall Works on Tuesday, and was constituted the occasion for the making of two important arrangements affecting the relations of the firms with their employés. It is well known that the firm have long desired to give some of the oldest foremen and workmen some slight interest in the business, but how this was to be done without conceding them all the rights and privileges of a large shareholder—a course which might be attended with serious inconveniences—was a difficult problem to solve. Messrs. Tangye have, however, at length initiated and adopted a scheme which is likely to work. It is this :—A certificate of indebtedness or bond of £50 is issued, setting forth that the holder is entitled to interest upon it at the same rate as the ordinary dividend declared by the company. The bonds have to be renewed at the end of each year, and in case the holder dies before the end of the year for which it is good his family is entitled to the value of the bond. Thus the bondholders enjoy all the pecuniary advantages of shareholders except that they cannot sell their shares; and they will be free from liability in event of bad times overtaking the concern. The families of bondholders coming under the formen's trust fund will receive £150 at the death of the holder, without having to contribute one penny towards it. An excellent provident scheme has also been formed for the benefit of all the workpeople. At the conclusion of the meeting of the company on Tuesday, Mr. R. Tangye delivered an address to about 1,300 of the operatives in explanation of the scheme. He remarked upon the amicable relations which existed between the company and their hands, and pointed out that for the past twenty-five years constantly increasing numbers of men, now aggregating thousands, had found regular and profitable employment at Cornwall Works. Rarely, indeed, had any workman been able to say that he left the works through slackness of trade. He hoped that at no distant date they would be able to extend their proposals for the workmen's benefit. If every man and boy would look at the property lying about the works as though it were his own, and resolutely set his face against its waste, the saving would enable the firm to give £50 to the family of every man dying in their employment from natural or any other cause. We do not often meet with a firm taking more care of their operatives. Mr. Tangye, in his address, stated that special precautions have been taken for dealing with accidents. "After this date the family or friends of any one who may unfortunately meet with a fatal accident whilst working for us, or, who from injuries received while working for us shall be unable to work, will, in the former case, receive a sum of money, and, in the latter case, a weekly sum, upon the following scale, without contributing a penny towards it :—In case of death, the friends of youths receiving weekly wages of 17s. or under will receive £25. Men with weekly wages between 17s. and 24s., £50; between 24s. and 30s., £75; and above 30s. per week, £100. In case of disablement, youths with weekly wages of 17s. a week or under, 5s. per week; men with weekly wages between 17s. and 30s., 10s. per week; and those above 30s., 15s. per week. I need hardly remind you that under the Employers' Liability Act, in case of an accident, a workman has no claim for compensation when it can be shown that he has contributed to the accident by his own fault; but we shall make no difference in that respect. The money will be paid in any case, but if you accept our proposal it will be only reasonable that we shall be exempted from any further liability. I want to explain to you that in the course of a few days every person on the ground will be asked whether he agrees to these proposals. He will have to sign in the same way as you sign now for permitting the office to deduct the dispensary money from your wages. If he accepts them, we shall be exempted from any further demand, because, obviously, it will not be fair for the same person to pay twice for the same thing. It will be in no degree obligatory on any one to sign his acceptance of those proposals. I hope the first result of these proposals will be to cause every man who is not in a club to at once join one." Finally, Mr. Tangye announced that the firm were going to give £1,000 to buy a piece of land on which to build baths and washhouses, and a similar donation to Mr. Jaffrey's hospital.—*Engineer.*

Mr. Darwin on Theism and Evolution.—This week the *Pall Mall* quotes the following letter from Charles Darwin, which appears in a work just issued :—"Dear Sir,—It seems to me absurd to doubt that a man be an ardent Theist and an Evolutionist. You are right about Kingsley. Asa Gray, the eminent botanist, is another case in point. What my own views may be is a question of no consequence to any one but myself. But, as you ask, I may state that my judgment often fluctuates. Moreover, whether a man deserves to be called a Theist depends on the definition of the term, which is much too large a subject for a note. In my most extreme fluctuations I have never been an Atheist in the sense of denying the existence of a God. I think that generally (and more and more as I grow older), but not always, that an Agnostic would be the more correct description of my state of mind.—Yours faithfully, Ch. Darwin."

Startling Scientific Statement.—In *Tit-Bits* the following instructive reply appears :—"A. L. D. We have tried the experiment of dropping a stone from the carriage-window whilst the train is in motion. We find that directly the stone has left our hand it loses the forward motion which it had whilst carried by the train, and being acted on only by gravity, it falls in a direct perpendicular line to the ground, and, consequently, when it touches the ground our hand is not directly over it, but is some little distance in front, varying with the speed at which the train is travelling. Perhaps, in performing your experiment, you have considered the words 'left behind' to mean that the whole body of the train has passed the stone before it touches the ground. The words were not intended to convey that impression. The stone is left behind the spot or part of the train from which it was dropped. We trust this explanation will make the matter clear to you." Galileo, Newton, and observed facts wrong after all!



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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SIR WILLIAM HERSCHEL.

[982]—With reference to letters 947 and 956, as to the statement by "A Fellow of the Royal Astronomical Society" that Sir William Herschel lost an eye observing the sun, I beg to point out that in Webb's "Celestial Objects" (3rd ed., p. 19) it is stated that "Galileo probably thus blinded himself wholly, and Herchel I. in part." A. H. S.

[In Smyth's "Bedford Cycle," Vol. I., p. 87, it is stated that Sir W. Herschel lost the sight of one eye in this way.—R. P.]

[983]—On my return home I lose no time in redeeming the promise to Colonel Herschel, given by me in Letter 956, p. 233. If, then, he will turn to p. 87 of Vol. I. of Smyth's "Celestial Cycle" (the "Prolegomena" to the "Bedford Catalogue") he will find its author saying, apropos of observing the sun:—"Nor is it wholly without danger. The illustrious Sir William Herschel lost an eye in this service, and I myself had a narrow escape from a similar disaster, by neglecting to reduce the aperture of the instrument." As Admiral Smyth was 34 years old at the time of Herschel's death, he may well have seen him face to face. Whether, though, he wrote the words I have quoted from personal knowledge, or from hearsay, I have no means of deciding.

A Fellow of the Royal Astronomical Society.

TRICYCLES (AN ERROR CORRECTED).

[984]—In No. 103, page 241, it is stated that Messrs. Larrette and Barrow rode on a tricycle 18 miles in 25 minutes. That would be at the rate of 43¼ miles an hour. It is probable that 1 hour and 25 minutes is meant. That is (circa) 12¾ miles an hour.

James Montague.

LARGE *v.* SMALL WHEELS FOR TRICYCLES.

[985]—I have read with considerable interest the correspondence upon this subject now publishing in your paper. There is, however, one question, and that the most important of all—safety—which both parties appear to have entirely overlooked. Increased speed is a very good thing, but it is not worth purchasing at the cost of increased risk of accident. I am now fast approaching sixty years of age, weigh considerably over fifteen stone, and have just returned from a run through Gravesend, Ramsgate, Dover, St. Leonards, Eastbourne, Brighton, Worthing, Portsmouth, Southampton, Winchester, Reading, Slough, and through Watford back into Hertfordshire.

I ride for health, exercise, and recreation, and to me speed occupies a very secondary place in comparison with safety. I ride a 50-inch Sparkbrook National, geared to 18 inches, or nearly level. When I am in the saddle my pedals have 1½ inches clearance, and my saddle is 37 inches from the ground, or 12 inches above the axle. The centre of gravity being so low, my weight acts as ballast, and the chances of an upset are very small indeed, so that I can turn even sharp corners with safety. Place me upon a machine with 36-inch wheels and my saddle will be exactly on a level with the tops of the wheels, and my weight, so far from serving as ballast to steady the machine, would in that elevated position simply tend to overthrow it. This fact alone is sufficient to condemn small wheels in my estimation. I shall be glad to hear from Mr. Browning what is his opinion upon this, to me, all-important point. W. W. D.

[986]—In view of the letters and articles which have lately appeared in Knowledge upon the subject of "Tricycle Wheels," perhaps I may be allowed a little space for the same subject.

A small machine geared to two speeds has these advantages, (1), lightness; (2), ease in climbing hills. Having small wheels which run round faster, the machines have the disadvantage of greater friction. The supporters of large wheels urge in their favour, (1), less friction; (2), more comfortable riding on rough roads. The opponents say that large wheels have the disadvantage of (1) greater weight, and (2) less adaptability to hill riding except by gearing down.

Now, the question is, taking all the pros and cons for each side, which is the best machine? that is, which gives the greatest possible speed with the least possible fatigue? We often wonder how there can be any diversity of opinion on this point, considering that there are so many tricyclists capable of judging. But, the fact is, each tricyclist can only judge of the particular machine or machines he has ridden, and very few men who hold opposite opinions are riding machines by the same maker. Besides this, one might add that what suits one man may be most unsuitable for another. One could hardly expect a man "born almost without muscles" to ride a large and heavy machine, but one can partly understand a strong rider like "Sigma" having a contempt for "geared-up castors."

However, the few considerations which follow may help to guide any one who has not ridden to the choice of a machine suitable to himself.

Consider first the small wheels geared high. The first advantage—viz., lightness—is so obvious, that I need hardly mention it. Although we cannot say that the weight of the wheel varies as its diameter, we can say small wheels are lighter than large ones. Now, on hills the weight of the machine is an important consideration, and tricycle riders in general will certainly "go for" anything which takes off the weight without lessening their speed. The convenience of changing gear for hills applies more to weak than to strong riders, but even to strong riders it is of importance for very steep hills. Much has been said of the connection between the "dead point" and hill-climbing. Some have asserted in Knowledge that the "dead point" occurs more frequently with small wheels than with large ones. It does not. The dead point has only to do with the pedals. It is the point where one pedal is up and the other down, and therefore no power is being applied. But if a machine with small wheels is geared up to the same speed as one with large wheels, that means that the pedals of both machines are going round at the same rate. The small geared wheels move round faster than large ones, and thus more friction is caused. This is a cause of complaint that will lessen every year, for ball-bearings are being continually improved. Still the fact remains that in small wheels geared up and having the most perfect bearings, the friction is greater than in large wheels. But is this not compensated by the less weight of the small wheels? In hill-climbing the large-wheeled tricycles may be geared down, but there is still the extra weight of the wheel.

The last point in favour of the large wheels is that of comfort. On rough roads there is no doubt that large wheels go more smoothly, and with less jerking over stones or similar obstacles; but in England the roads are generally speaking good, and by thick rubber tires we can take away much of that inconvenience.

Leaving this for the consideration of your readers—that is, if you choose to insert it, Thomas B. Walker.

ANTHROPOMETRY.

[987]—In reply to "Hallyards" (970) I would say that the conclusion as to tallness or shortness being a racial peculiarity is due to the Anthropometric Committee of the British Association, and not to myself. At the same time, if a humble outsider may say so without presumptuousness, I fully concur in their conclusion. Races of men *do* differ noticeably in height, *e.g.*, Japanese and Patagonians, Finns and Swedes, Bushmen and Zulus, Esquimaux and Red Indians. Increased food and ease of life no doubt tend to make individual members of each race attain the highest development of that race, but they do not, apparently, tend to make Japanese (for example) grow as tall on the average as lowland Scots, unless (perhaps) the favourable conditions be extended over a very long space of time, and (probably) be accompanied by special selective action, sexual or natural. If "Hallyards" will read the Report of the Anthropometric Committee, and also the writings of Dr. Beddoes, Dr. Thurnam, Prof. Rollestone, and other ethnologists, he will, probably, be convinced that size and shape of bone is a remarkably constant racial feature, and he may, perhaps, be surprised to find how wonderfully such small personal peculiarities often persist from generation to generation.

As to "Hallyards'" two particular examples, I should like to ask him, first, how does he know that the Lowland Scots

of the coast are "identical in race" with Lowland Scots of the interior? I should have thought the historical probabilities were all the other way. On the east coast, the blood in all likelihood is mainly Anglian with a slight Scandinavian admixture; on the west coast, we know that Galloway was Pictish, while Strathclyde was Cymric; and there is no proof that the Celt was ever here displaced: inland, it seems to me probable, that there would be a larger survival or intermixture of the still earlier Neolithic race, who were doubtless driven from the east coast by the conquering Teuton, and from the west coast by the Pict and Cumbrian. Of course, all this is very problematical; but at any rate, in a case where we know that at least four, and probably five, races are involved, I don't see how we can speak confidently about "identity" of blood. And, secondly, as to Tipperary, I know nothing myself at first hand about the facts; but I have been told (I can't say whether on good authority) that two-thirds of the Tipperary peasant-farmers are the descendants of Cromwellian soldiers, in which case they ought certainly to be of different race from the Celts of Kerry, the Northmen of Cork, or the Neolithic people of some scattered Irish regions. Perhaps somebody who understands Irish ethnology will kindly give us some information as to the Tipperary men. GRANT ALLEN.

THE BARN OWL.

[988]—No doubt Kerry Rix [968] is quite right in his statement that barn owls do occasionally feed on young game birds, though I have never met with an instance to that effect in my own experience. Still, such cases are very exceptional, and as a whole, the owl must be looked upon as the farmer's friend, from the vast quantity of rats, mice, and other small mammals that he destroys. Dr. Altam examined 706 pellets of the barn owl, and found in them the bones of various animals in the various proportions:—Shrews, 1,590; voles, 693; mice, 237; rats, 3; bats, 16; birds, 22. Colonel Irby, who has investigated the question very carefully, says, "Old birds they have not the power to kill, and young pheasants and partridges, at the time the owls are on the feed, are being safely brooded by the parent birds." Kerry Rix will find a full discussion on the subject in Mr. Bowdler Sharpe's article "Birds," contributed to Professor Martin Duncan's "Cassell's Natural History," vol. iii., p. 306, &c. That owls will eat young pheasants reared by hand I can readily believe: no doubt they will eat anything they can catch: but, on the whole, they certainly do more good than harm, from a strictly human point of view. What the mice and shrews think of them is quite another question. GRANT ALLEN.

LARGE SUN SPOTS.

[989]—I see in to-day's KNOWLEDGE, illustrations and descriptions by "Vignoles" (letter 964), of some very large sun spots visible about Oct. 11 and 12. I had not an opportunity of observing the sun on those days, but on turning my telescope towards him on Monday last, Oct. 15, a beautiful sight rewarded me, for there were three very fine groups of spots, or, besides many other smaller spots, two of the groups being near the western edge. On procuring my ever-ready piece of smoked glass, I found that two of the groups, the one near the eastern edge and one of those near the western edge were distinctly visible to the unaided eyes, each as a single spot of course.

I do not remember ever to have known two spots visible to the naked eye at the same time before, and I see that "T. P. B." (letter 962), in to-day's KNOWLEDGE, makes a similar statement, but as he refers to spots visible on Oct. 11, one of them could not be the same that I saw on the 15th, for one of those I saw was only just coming on at the eastern edge when I saw them, and so could not have been visible on the 11th at all; therefore it would appear that there were three spots visible to the naked eyes within a space of four days, a circumstance totally unprecedented, as far as I know, and giving striking evidence of the awful nature of the disturbance taking place on the sun's surface (if I may so term it) at that time.

On Tuesday, Oct. 16th, I again examined the sun through my smoked glass, and found the spot near the western edge no longer visible to the naked eyes, being carried too near the edge by the sun's revolution, while, of course, the same revolution had brought the one near the eastern edge more fully into view, and it was proportionately more distinctly visible, and I again observed it in the same way on the two following days; but on the 9th the sun was entirely obscured by clouds, so that I had no opportunity of looking for the spot.

While writing I would like to suggest to "F.R.A.S." that he might include in "The Face of the Sky," for the benefit of amateur astronomers, some information as to the position, &c., of comets when there are any visible, as I think they are very interesting objects to watch, and I understand there have been two small ones visible recently, yet he has never so much as mentioned them, although I think he will not deny that they would interest many if he would give a few plain hints as to where they might be found.

EXCELSIOR.

THE HANGMAN.

[990]—Thank you for your courtesy. I think it was about two years ago that I read in some newspaper how Marwood, when passing through part of Ireland on his way to discharge his duties in the case of some rebel convicts, was reviled and threatened by some Irishmen who recognised him, and who also knew what was the object of his journey. A lady in the train, seeing that he was in some danger, and sympathising with the justice of his mission rather than with Fenianism and Phœnix Park atrocities, entered his carriage and sat beside the threatened executioner for the rest of his journey, in order to throw the ægis of her protection, whatever it might be worth, over him. When I read this I admired and most heartily sympathised with this lady. Evidently she, like myself, viewed the work of an executioner as a necessary and just, and therefore a fully-justified if not praiseworthy, work—all the more praiseworthy considering the cloud of degradation which is cast over both the office and the man by sympathy with crime in some cases and superficial prejudice in others. She clearly did not, as you as clearly do, attribute bad motives to every occupant of the office.

If from the fact that the executioner takes life, it necessarily follows (as you assume to be the case) that he *delights* [I used no such expression, but the mistake is of a piece with the rest.—R. P.] in taking life, how about the *Judge* who sentences the criminal to death? And the *Sheriff*, with whom the responsibility of the executions primarily rests? And the *soldier*, who is sometimes the agent of homicide even in an unjust cause? Do we—will you—impute bad motives to all of these? And why not to these, if to the executioner. Is there any proof that even one executioner has loved killing *as* killing? Yet would it not be wonderful if executioners were men of degraded disposition! For what is so likely to debase the tone of a man's mind as the belief of all his neighbours that he is already debased? To me it seems equally unscientific and illogical to impute motives in the sweeping way you do, and yet offer no proof beyond assertion.

E. D. GIRDLESTONE.

[The office of the Judge is quite as much to see that the innocent shall not suffer as that the guilty shall. *The hangman's is the one office where the sole duty is to take life.* In none other is it even the chief duty. So long as there is no difficulty in finding hangmen none need take the office as a matter of duty. In these points will be found a full and sufficient answer to the above reasoning.—R. P.]

INSANITY AND CRIME.

[991]—In a leader (Oct. 20) on "Insane Criminals," experts in diseases and derangements of the brain are decried by the *Times* as mere theorists, and termed "inventors of a *quasi*-scientific terminology and jargon. It is forgotten that the law, in dealing with responsibility in criminals, has come down to us from a time when the densest ignorance prevailed on the relation of mind and body. And if now but imperfectly understood, there are at least certain data which may be regarded as affording a reliable basis on which to work, and the fact that the treatment of insane patients is so far more successful than of old, is a sufficient proof of the advance of scientific truth. The position of science on the subject, up to which the public mind, *pace* the *Times*, is being gradually educated, briefly stated, is clearly this: Mind is a function of the brain, and not an entity independent of the organisation. Our tendencies are congenital and hereditary; we are, in fact, what our ancestors have made us, leaving, of course, a margin as to the direction of development according to the conditions of our lives. And the result of the scientific position is that when a crime is committed for which no adequate motive can be assigned, and there is found to be (as, indeed, is almost invariably the case) brain disease in the family of the criminal, the presumption is that the criminal inherits the insane *neurosis* in some form or another. If this be *truth*—and it would be hard to refute it—it is useless to meet it by the abuse and ridicule of scientific men. All truth is sacred, and therefore, instead of quailing before it, or crying out in anger when new truth presents itself, the only thing to do is to revise one's notion of the situation. Society must be protected, and who can doubt that it will be? But it is mere twaddle to talk of the common sense of the law and of juries, on a question respecting which a safe judgment can be formed only by a knowledge—not of theories—but of physiological facts. H. A. BULLEY.

LETTERS RECEIVED AND SHORT ANSWERS.

Alex. A. Rodger. Your contempt for "Vegas and John Fiskes," *et hoc genus omne*, must extend to and include me also. Can you not see that the God they speak of is but a symbolisation? They advance no dogma, would force no ideas about the nature of Deity on men unwilling to accept even the thought of deity. But the freedom of thought about which you are so earnest is a strange sort of freedom if it means that they or I or any who think as we do, are to be silent because there are some who can stand face to face with the mighty mysteries of the universe and not feel that at the back of those mysteries there lies a greater mystery yet, the mystery of the Infinite Unknown, "yea evermore Unknowable," but as manifestly *there* to us as the sun is in the mid-heaven even when his light so blinds us that we cannot see him because of his very glory. If our widening recognition of the infinite extension of the universe alike in space and time, our clearing perception of the infinite range of the laws of the universe, the mystery of universal gravity, the mystery of eternal evolution, are to lead to the belief that *there* within the region of the known lies all, then were it better—so far as the worth of life is concerned—that no advance towards wider knowledge should ever have been made. But as reasonably might the student of some complex mechanism, who had traced a few links of the connecting chains or watched the movements of some half-dozen cogs, pretend that the whole plan and purpose of the machinery was known to him, the whole scope even of the mind and character of its constructor. I have no wish to convince you that your view of the universe is narrow and unworthy. But in common honesty I must tell you that if you or any other readers of Knowledge suppose my refusal to admit religious discussions into these pages involves the rejection of all reference to a Power outside the known, and working (unknowably by us) in and through all things, then you labour under a considerable delusion. You speak of freedom of thought, by the way; but the contempt and rancour you express are altogether inconsistent with real freedom.—B. Walker. *You* enter *another* debatable region. You speak, however, of feelings of rancour and animosity which do not exist. Most students of science simply do not concern themselves with the questions you raise. I have mixed a good deal with them, and I know that it is so. You might as reasonably talk of the feelings of rancour and animosity entertained by fishermen towards land-surveyors, or by any class of men towards another class in whose pursuits they happen to take no special interest. Do you imagine that when Mr. Allen speaks of the evolution of some plant or animal he is expressing the rancour and animosity which he feels towards those folk (now few among the intelligent) who fancy evolution in some way inconsistent with doctrines dear to them, or that when I speak of the tens of millions of years of which the crust (God's work, and therefore His word) tells us, that I want to hurt the feelings of those who find a few thousand years of work as much as they can believe God capable of? So when Mr. Clodd speaks of the origin of myths, or Mr. Foster speaks of what the Spencerian school holds (and I think rightly) to be the origin and true meaning of moral laws, can you for a moment imagine that they are moved by feelings of ill-will towards those who think, or think they think, such ideas must be erroneous (let the evidence be what it may)? *When* we feel so, some system of reconciliation such as you suggest may be wanted. But it will, I fancy, be a long time first. When you speak of "determined, indeed bitter, opposition" where we are, in truth, absolutely unconcerned, you remind me of the way in which some school-girls quarrel, who, when annoyed by perfect coolness, pretend to see fierce anger. "You needn't get angry, dear," they will say; "your hair's coming out of curl." Allow me to assure you we are not troubled by the anger you imagine: our hair curls quite sweetly still.—S. Griffin. The advantages claimed for the Christy over the Amici have no real existence, though claimed—Paul gets what is taken from Peter.—W. D. B. I said each star had been seen with a telescope $2\frac{1}{2}$ in. in aperture, not that such a telescope would show such regions as appeared in my maps with all those stars simultaneously visible. The chart results from picturing in a single view the stars seen when such a telescope is laboriously directed to part after part of the heavens.—E. Ratcliff. I would gladly answer if I knew, but I do not know, whether condensed sea-water (meaning, I suppose, distilled) is used on board any vessels for drinking purposes.—E. Anderson. I quite agree with you. The system may be *necessary* for many, as in the training of children. Those I have learned to love and esteem most of all whom, thus far in my life, I have known, have been absolutely free from both the fears and the hopes to which you refer. But many doubt whether that state of mind is possible or even conceivable. The passage you quote is indeed absurd—but the reporter may be in fault. "No telescope can show God!" No; nor can the conscience be analysed in a laboratory, or the soul investigated with a microscope. But he might with equal sense have said (to use Sydney Smith's illustration of nonsense) that you can't "ride to London on a pound of pickled salmon."—Enquirer. I know nothing of the rules relating to debts of honour, absurdly so called. I am sorry to learn that so fine a game as whist should ever be played for stakes large enough to be worth troubling about.—C. E. Hanson. No not like the moon; that stage would be a far later one. But the earth would become entirely water covered through the washing away of all her upraised portions, were it not for subterranean action renewing the inequalities of level. The disappearance of water would, much later, be brought about by the gradual withdrawal of the seas into porous cavities in the cooled crust and nuclear regions.—Omega. Thanks. I try to please as many as possible,—a Spencerian system on a small scale.—G. M. Nearly always, when a communication is not acknowledged in this part of Knowledge, it may be taken for granted that it has been marked for insertion. But sometimes considerable delay intervenes between this and the appearance of the letter. It should be clear to you, however, that there could not have been any idea of annoying you, in any case. Look at my lecture advertisements and you will (or should) be prepared to understand and forgive occasional delays.—Steam Roller. You are right; there must be continual, though slight, sliding: this is no doubt intended.—R. W. J. It seems likely enough that in a number of cases the cure was a mere coincidence; but there are so many much more remarkable illustrations of the influence of the mind on the body that we must take that into account.—Chas. A. Edes. Many thanks for your very curious and interesting work on "Papyrography," which I hope shortly to "notice."

Our Mathematical Column.

THE PHILOSOPHY OF MATHEMATICS.*

By Professor A. Cayley.

IN TWO PARTS.—PART II.

(*Continued from page 205.*)

It is interesting to consider two different ways in which, without any modification at all of our notion of space, we can arrive at a system of non-Euclidian (plane or two dimensional) geometry; and the doing so will, I think, throw some light on the whole question.

First, imagine the earth a perfectly smooth sphere; understand by a plane the surface of the earth, and by a line the apparently straight line (in fact an arc of great circle) drawn on the surface; what experience would in the first instance teach would be Euclidian geometry; there would be intersecting lines which, produced a few miles or so, would seem to go on diverging; and apparently parallel lines which would exhibit no tendency to approach each other; and the inhabitants might very well conceive that they had by experience established the axiom that two straight lines cannot enclose a space, and the axiom as to parallel lines. A more extended experience and more accurate measurements would teach them that the axioms were each of them false; and that any two lines, if produced far enough each way, would meet in two points; they would, in fact, arrive at a spherical geometry, accurately representing the properties of the two-dimensional space of their experience. But their original Euclidian geometry would not the less be a true system: only it would apply to an ideal space, not the space of their experience.

Secondly, consider an ordinary, indefinitely extended plane; and let us modify only the notion of distance. We measure distance, say, by a yard measure or a foot rule,

* Abstract of that portion of Professor Cayley's Address before the British Association at Southport which relates to the philosophy of Mathematics and to certain recent ideas respecting non-Euclidian Geometry and space of more than three dimensions.

anything which is short enough to make the fractions of it of no consequence (in mathematical language by aninfinitesimal element of length); imagine, then, the length of this rule constantly changing (as it might do by an alteration of temperature), but under the condition that its actual length shall depend only on its situation on the plane and on its direction—viz., if for a given situation and direction it has a certain length, then whenever it comes back to the same situation and direction it must have the same length. The distance along a given straight or curved line between any two points could then be measured in the ordinary manner with this rule, and would have a perfectly determinate value; it could be measured over and over again, and would always be the same; but of course it would be the distance, not in the ordinary acceptation of the term, but in quite a different acceptation. Or in a somewhat different way; if the rate of progress from a given point in a given direction be conceived as depending only on the configuration of the ground, aud the distance along a given path between any two points thereof be measured by the time required for traversing it, then in this way also the distance would have a perfectly determinate value; but it would be a distance, not in the ordinary acceptation of the term, but in quite a different acceptation. And corresponding to the new notion of distance we should have a new, non-Euclidian system of plane geometry; all theorems involving the notion of distance would be altered.

We may proceed further. Suppose that as the rule moves away from a fixed central point of the plane it becomes shorter and shorter; if this shortening takes place with sufficient rapidity, it may very well be that a distance which in the ordinary sense of the word is finite will in the new sense be infinite; no number of repetitions of the length of the ever-shortening rule will be sufficient to cover it. There will be surrounding the central point a certain finite area such that (in the new acceptation of the term distance) each point of the boundary thereof will be at an infinite distance from the central point; the points outside this area you cannot by any means arrive at with your rule; they will form a *terra incognita*, or rather an unknowable land; in mathematical language, an imaginary or impossible space; and the plane space of the theory will be that within the finite area—that is, it will be finite instead of infinite. We thus with a proper law of shortening arrive at a system of non-Euclidian geometry which is essentially that of Lobatschewsky. But in so obtaining it we put out of sight its relation to spherical geometry; the three geometries (spherical, Euclidian, and Lobatschewsky's) should be regarded as members of a system—viz., they are the geometries of a plane (two-dimensional) space of constant positive curvature, zero curvature, and constant negative curvature respectively; or again they are the plane geometries corresponding to three different notions of distance; in this point of view they are Klein's elliptic, parabolic, and hyperbolic geometries respectively.

Next, as regards solid geometry, we can by a modification of the notion of distance (such as has just been explained in regard to Lobatschewsky's system) pass from our present system to a non-Euclidian system; for the other mode of passing to a non-Euclidian system it would be necessary to regard our space as a flat three-dimensional space existing in a space of four dimensions (*i.e.*, as the analogue of a plane existing in ordinary space); and to substitute for such flat three-dimensional space a curved three-dimensional space, say of constant positive or negative curvature.

In regarding the physical space of our experience as possibly non-Euclidian, Riemann's idea seems to be that of modifying the notion of distance, not that of treating it as a locus in four-dimensional space.

I have just come to speak of four-dimensional space. What meaning do we attach to it? Or can we attach to it any meaning? It may be at once admitted that we cannot conceive of a fourth dimension of space; the space as we conceive of it, and the physical space of our experience, are alike three-dimensional; but we can, I think, conceive of space as being two or even one-dimensional; we can imagine rational beings living in a one-dimensional space (a line) or in a two-dimensional space (a surface) and conceiving of space accordingly, and to whom, therefore, a two-dimensional space, or (as the case may be) a three-dimensional space would be as inconceivable as a four-dimensional space is to us. And very curious speculative questions arise. Suppose the one-dimensional space a right line, and that it afterwards becomes a curved line; would there be any indication of the change? Or, if originally a curved line, would there be anything to suggest to them that it was not a right line? Probably not, for a one-dimensional geometry hardly exists.

But let the space be two-dimensional, and imagine it originally a plane and afterwards bent (converted, that is, into some form of developable surface) or converted into a curved surface; or imagine it originally a developable or curved surface. In the former case there should be an indication of the change, for the geometry originally applicable to the space of their experience (our own Euclidian geometry) would cease to be applicable; but the change could not be apprehended by them as a bending or deformation of the plane, for this would imply the notion of a three-dimensional space in which this bending or deformation could take place. In the latter case their geometry would be that appropriate to the developable or curved surface which is their space—viz., this would be their Euclidian geometry; would they ever have arrived at our more simple system?

But take the case where the two-dimensional space is a plane, and imagine the beings of such a space familiar with our own Euclidian plane geometry; if, a third dimension being still inconceivable by them, they were by their geometry or otherwise led to the notion of it, there would be nothing to prevent them from forming a science such as our own science of three-dimensional geometry.

Evidently all the foregoing questions present themselves in regard to ourselves, and to three-dimensional space as we conceive of it, and as the physical space of our experience. And I need hardly say that the first step is the difficulty, and that granting a fourth dimension we may assume as many more dimensions as we please. But whatever answer be given to them, we have, as a branch of mathematics, potentially, if not actually, an analytical geometry of n-dimensional space.

Coming now to the fundamental notion already referred to, that of imaginary magnitude in analysis and imaginary space in geometry, I connect this with two great discoveries in mathematics made in the first half of the seventeenth century, Harriot's representation of an equation in the form $f(x) = 0$, and the consequent notion of the roots of an equation as derived from the linear factors of $f(x)$, and Descartes' method of co-ordinates, as given in the "Géometrie." By these we are led analytically to the notion of imaginary points in geometry; for instance, we arrive at the theorem that a straight line and a circle in the same plane intersect always in two points, real or imaginary. The conclusion as to the two points of intersection cannot be contradicted by experience; take a sheet of paper and draw on it the straight line and circle, and

try. But you might say, or at least be strongly tempted to say, that it is meaningless.

The question, of course, arises, What is the meaning of an imaginary point? and further, In what manner can the notion be arrived at geometrically? There is a well-known construction in perspective for drawing lines through the intersection of two lines, which are so nearly parallel as not to meet within the limits of the sheet of paper. You have two given lines which do not meet, and you draw a third line, which, when the lines are all of them produced, is found to pass through the intersection of the given lines. If instead of lines we have two circular arcs not meeting each other, then we can, by means of these arcs, construct a line; and if on completing the circles it is found that the circles intersect each other in two real points, then it will be found that the line passes through these two points; if the circles appear not to intersect, then the line will appear not to intersect either of the circles. But the geometrical construction being in each case the same, we say that in the second case also the line passes through the two intersections of the circles. Of course, it may be said in reply that the conclusion is a very natural one, provided we assume the existence of imaginary points; and that, this assumption not being made, then, if the circles do not intersect, it is meaningless to assert that the line passes through their points of intersection. The difficulty is got over by the analytical method before referred to, for this introduces difficulties of its own; is there in a plane a point the co-ordinates of which have given imaginary values? As a matter of fact, we do not consider in plane geometry imaginary points introduced into the theory analytically or geometrically as above. The like considerations apply to solid geometry, and we thus arrive at the notion of imaginary space as a *locus in quo* of imaginary points and figures.

I have used the word imaginary rather than complex, and I repeat that the word has been used as including real. But, this once understood, the word becomes in many cases superfluous, and the use of it would even be misleading. Thus, "a problem has so many solutions;" this means, so many imaginary (including real) solutions. But if it were said that the problem had "so many imaginary solutions," the word "imaginary" would be here understood to be used in opposition to real. I give this explanation the better to point out how wide the application of the notion of the imaginary is—viz. (unless expressly or by implication excluded), it is a notion implied and presupposed in all the conclusions of modern analysis and geometry. It is, as I have said, the fundamental notion underlying and pervading the whole of these branches of mathematical science.

In geometry it is the curve, whether defined by means of its equation, or in any other manner, which is the subject for contemplation and study. But we also use the curve as a representation of its equation—that is of the relation existing between two magnitudes x, y, which are taken as the co-ordinates of a point on the curve. Such employment of a curve for all sorts of purposes—the fluctuations of the barometer, the Cambridge boat races, or the Funds—is familiar to most of you.

It is in like manner convenient in analysis for exhibiting the relations between any three magnitudes, x, y, z, to regard them as the co-ordinates of a point in space; and, on the like ground, we should at least wish to regard any four or more magnitudes as the co-ordinates of a point in space of a corresponding number of dimensions. Starting with the hypothesis of such a space, and of points therein each determined by means of its co-ordinates, it is found possible to establish a system of n-dimensional geometry analogous in every respect to our two- and three-dimensional geometries, and to a very considerable extent serving to exhibit the relations of the variables. It is to be borne in mind that the space, whatever its dimensionality may be, must always be regarded as an imaginary or complex space such as the two or three-dimensional space of ordinary geometry; the advantages of the representation would otherwise altogether fail to be obtained.

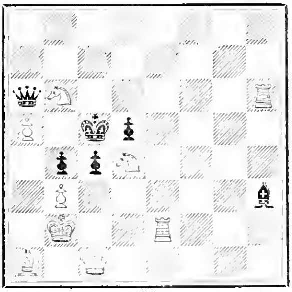
Our Chess Column.

By Mephisto.

PROBLEM No. 103.

By E. N. Frankenstein.

Black.



White.

White to play and self-mate in 5 moves.

(A very ingenious conception.—Ed.)

Solution.—Problem No. 102, p. 250.

1. Kt to Kt sq	Kt to B6 (ch), or 1.		Kt to B8
2. B takes Kt	Kt to Kt3 (ch)	2. B to B7	P to R3
3. K to K6	K to K5	3. B to Q8	any move
4. R to K2 mate		mates accordingly	

Members of the fairer sex have a more sensitive and complex nervous system, rendering them more susceptible to mental influence than their less gifted masculine fellow-creatures. Hence, in accordance with the theory advanced in our recent article on the subject of mind influence, the Chess play of ladies would be more inclined to vary through this influence than that of men. The idea is certainly supported by the fact that we have not many strong lady Chess players. We will not, however, now examine whether this disadvantage only forms the minor obstacle to success, or whether the want of perseverance and powers of concentration of thought, are the real causes of failure in feminine Chess practice. We will chivalrously assume the former to be the major and not the minor obstacle, especially as it may be possible that a too extensive practice of Chess playing amongst ladies would result to the disadvantage of us men.

Notwithstanding, a little more attention might be given by ladies to our noble game; for only in this wise can the earnest ideal of Mr. Lamb, the President of the North London Chess Club, be realised. At the recent very successful annual dinner of the North London Chess Club, the worthy President expressed it as his sincere conviction that Chess ought to be taught to the young. "Chess strengthens the intellect," he remarked, "induces cautious habits and steadiness, and is likely to keep the superabundant spirit of youth within bounds, besides initiating the child in a recreation which if indulged in moderately would be a constant source of pleasure in after-life." Who is there, we ask, more fit to teach Chess to the young than ladies?

To assist such of our fair readers as wish to gain a good insight into the subtleties of Chess, we will this week enter more fully than

usual into the spirit of a game, by analytically explaining every move.

1. P to K4

There are also other ways of opening a game besides P to K4, as, for example, KKt to KB3 or P to Q4, P to QB4, P to KB4, &c. P to K4 is the more general, and usually leads to an open game, most suitable for beginners. The other first moves enumerated mostly lead to close games, requiring a close reasoning and a subtlety in play suitable to more advanced players.

1. P to K4.

P to K3, called the French defence, may also be played, but it likewise leads to a close game. The main object in a game is to capture the King; this is facilitated by capturing your opponent's pieces, to do which you must occupy the most favourable positions for attack. P to K4, besides commanding two centre squares, favours the development of the pieces, a very important point. It liberates the Queen and Bishop.

2. KKt to KB3.

It is always a gain of time to develop a piece by attacking one of your opponent's pieces, in this case the King's Pawn. Black must defend this, which gives time for another developing move. The King's Knight and King's Bishop are played early in the game to enable castling, which brings the King into safety by being more out of the reach of the hostile pieces, therewith also giving more freedom for attack.

2. QKt to QB3

Protects the King's Pawn by bringing a piece into play. This move is decidedly better than to defend the King's Pawn by (*a*) P to Q3; this prevents the King's Bishop from getting into good play, and therefore retards castling, which is unfavourable to the development of Black's game. (*b*) P to KB3 is not good, as a rule, early in the game, as the Queen has command of the square on KR5. For instance, if Black plays 2. P to KB3, White can sacrifice the Knight with 3. Kt takes KP; if Black then replies 3. BP takes Kt, White will play 4. Q to KR5 check, 4. P to Kt3. 5. Q takes KP check, 5. K to B2, 6. Q takes KR, winning. (*c*) 2. B to Q3 is very bad, because it blocks the Queen's Pawn, and thus prevents the Queen's Bishop from coming into play, besides restricting the action of the King's Bishop. 2. Q to K2 blocks the King's Bishop, and 2. Q to KB3 is not good, because it is advisable to develop the minor pieces before bringing the Queen into play. 2. KKt to KB3 is also possible, for although it does not defend the King's Pawn, it is a counter attack on the White King's Pawn; but this leads to a complicated game.

3. KB to QB4.

The King's Bishop's Pawn is weak, as it is only defended by the King, and may also be attacked by Kt to Kt5, Q to B3, &c.

3. KB to QB4.

The best move. If, for example, 3. KKt to B3, which constitutes the two Knights' Defence, instead of KB to QB4, then White can at once attack the King's Bishop's Pawn by playing KKt to Kt5. The Pawn can only be defended with some inconvenience by Black, who has to play P to Q4, and temporarily abandon the Queen's Pawn in defence of the KBP.

4. P to QB3.

Threatening to play P to Q4, and obtain a commanding position with his two centre Pawns, besides shutting off the Black Bishop from the weak spot on KB7. This continuation is called the Giuoco Piano. Other good continuations are either 4. Castles, or 4. P to Q3.

4. KKt to KB3.

This is recognised as the best defence in this position, as it attacks the White King's Pawn. It is better than 4. P to Q3, to which White could reply with 5. P to Q4, attacking the King's Bishop, and threatening to play KKt to Kt5. 4. Q to K2 is also less favourable to the development of Black's game.

5. KKt to Kt5.

At attacking move, but, as Black is enabled to Castle, the move ought not to avail against good play.

5. Castles.

The best move to defend the King's Bishop's Pawn.

6. P to Q3.

Defending his King's Pawn against the Black Knight, in case the White Knight on Kt5 should be compelled to retire, and also liberating his Queen's Bishop.

6. P to KR3.

With the intention of forcing the White Knight to retire, in which case, of course, White's move of 5. KKt to Kt5 would merely have been time wasted.

7. P to KR4.

White abandons the Knight, as he hopes to be compensated for the sacrifice by obtaining command of the Rook's file for his Queen, supported by the Rook, by playing Q to R5, which would threaten mate.

7. P takes Kt.

A very injudicious capture. Black here ought to play 7. P to Q3, instead of P takes Kt, for, after 7. P to Q3, it would be safe for Black to play 8. P takes Kt, for Black would immediately follow this up by 9. QB to KKt5, attacking the Queen and preventing her from playing to the desired spot on QR5. Of course, if Black plays 7. P to Q3, White can retire his Knight from Kt5, but Black would remain with a superior development.

8. P takes P.

Attacking the Knight and threatening Q to R5.

8. KKt to KR2.

This allows the dangerous move of Q to R5 to be played. Black would have done better for the present if he had played P to KKt3, abandoning the Knight at once, but preventing the fatal Q to R5.

9. Q to R5.

Threatening Q takes Kt mate.

9. KR to K sq.

This makes room for the King. Black had nothing else to defend the mate; the KBP, of course, cannot move, as it is pinned by the white Bishop.

10. Q takes BP check.

As will be seen, this move brings about a pretty mate in three moves, and is, therefore, superior to Q takes Kt, in which case the mate would be delayed.

10. K to R sq.

11. R takes Kt check. 11. K takes R.

12. Q to R5 mate.

[P. 235]—I was much pleased with the paper on the influence of mind over mind in chess play. In my opinion, a *very slow* player frequently throws his opponent into a kind of stupor or somnolent state, in which he is really almost unconscious of the move he is making—oftentimes a very bad one indeed—a surprise to himself and every one else.—John.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.***

Alpha.—A Pawn cannot take a piece en passant.

G. R. M.—Mr. Cook, Birmingham Chess Club.

H. Twinner.—Game received, with thanks.

Walter Waring.—Problem received, with thanks; will be examined.

Correct solutions received.—Problem 102, Henry Bristow, M. T. Hooton.

All the Tourney Problems have been correctly solved by W. and Clarence. Good solvers think them below the average of good Tourney Problems.

Correction.—In the Two-mover Emu the Kt on White K sq is a Black Knight.

Contents of No. 104.

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CONTENTS OF NO. 106.

THE MORALITY OF HAPPINESS.

BY THOMAS FOSTER.

(*Continued from page 254.*)

THERE is only one way of escape from the conclusion reached in our last,—that conduct is good or bad according as its total effect are pleasurable or painful,—in which statement be it understood the word total *means* total and is not limited in its application to the person whose conduct is spoken of. If it is supposed that men were created to suffer, that a power which they were bound to obey had planned such suffering, so that any attempt either to take pleasure or to avoid pain was an offence, then of course the conclusion indicated is an erroneous one.

No system of religion has ever definitely taught so hideous a doctrine. Even where sorrow and suffering are recognised as the lot of man, and even where self-inflicted anguish and misery are enjoined as suitable ways of pleasing Deity, it is never said that such sufferings are the ultimate desire of the Supreme Power. These tribulations are all intended for our good: we are to torture ourselves here and now that hereafter we may avoid much greater pains or enjoy much greater pleasures than here and now we could possibly experience.

Yet underlying this doctrine of greater and longer-lasting happiness as the result of temporary suffering or privation, there has been and is in many so-called religions the doctrine that pain and suffering are pleasing to the gods of inferior creeds and even to the Supreme Power of higher beliefs. The offerings made systematically by some races to their deities imply obviously the belief that the gods are pleased when men deprive themselves of something more or less valued. Sacrifices involving slaughter, whether of domestic animals or of human beings, mean more, for they imply that suffering and death are essentially pleasing to deity. Even when such gross ideas are removed and religion has been purified, the symbolisation of sacrifice in most cases takes the place of sacrifice itself. The conception may and often does remain as an actually vital part of religious doctrine that pleasure is offensive to the Supreme Power and pain pleasing.

If this conception is really recognised and any men definitely hold that to enjoy or to give pleasure is sinful, because displeasing to God, while the suffering or infliction of pain is commendable, then for them—but for them only—the doctrine is not established that conduct is good or bad according as its total effects are pleasurable or painful. But if there are such men, then they are mentally and morally the direct descendants of the savage of most brutal type, who because he himself delights to inflict pain deems his gods to be of kindred nature and immolates victims to them (or if necessary to gain his ends, shows the reality of his belief by self-torture) to obtain their assistance against his enemies.

If there are such men among us still, then as Mr. Herbert Spencer says, "we can only recognise the fact that devil-worshippers are not yet extinct." The generality of our conclusions is no more affected by such exceptions as these than it is by the ideas which prevail in Bedlam or Earlswood.

But on the one hand the doctrine thus reached may be passed over as a truism (which it ought to be and indeed is, though like many truisms, unrecognised); and on the other it may be scouted as Epicurean (which is unmeaning nonsense, however) and as mere pig-philosophy. For it sets happiness as the aim of conduct, and whether self-happiness or the happiness of others is in question, many find in the mere idea of pleasure as a motive for conduct something unworthy,—thereby unconsciously adopting the religious doctrine which has been justly compared with devil-worship.

This expression — Pig-philosophy — has indeed been applied to the doctrine we are considering, by a philosopher who, with Mr. Ruskin and Mr. Matthew Arnold, may be regarded as chief among the wonders of our age—and standing proof of the charm which the British race finds in Constant Grunt, Continual Growl, and Chronic Groan. It must be considered, therefore, as certain that to some minds a philosophy which sets the happiness of self and others as a worthy end, must appear unworthy. Such minds find something pig-like in the desire to see the happiness of the world increased. Yet grunting and groaning are at least as characteristic of the porcine race as any desire to increase the comfort of their fellow-creatures or even their own. Mr. Herbert Spencer's lightsome pleasure-doctrine, the essence of which is that we should strive to diminish pain and sorrow (our own included) and to increase joy and happiness, is less suggestive of porcine ways (at least to those who have noted what such ways are) than—for instance—the following cheerful address to Man, "Despicable biped! what is the sum total of the worst that lies before thee? Death? Well, Death; and say the pangs of Tophet, too, and all that the Devil and Man may, will, or can do against thee! Hast thou not a heart; canst thou not suffer whatsoever it be; and, as a Child of Freedom, though outcast, trample Tophet itself under thy feet, while it consumes thee?" Were this but stern resolution to endure patiently, and even cheerfully such sorrows as befall man, it were well. Nay it would fall in with the philosophy of happiness, which enjoins that for their own sake as for the sake of those around them men should bear as lightly as they may their burden of inevitable sorrow. But what Carlyle calls the New-birth or Baphometic Fire-baptism is not Patience but Indignation and Defiance. This is the veritable Pig-philosophy: the "Everlasting No" (*das ewige Nein*) is in truth the Everlasting Grunt of dyspeptic disgust, the constant Oh-Goroo-Goroo of a jaundiced soul.

Are the teachings of living professors of the Everlasting Groan school brighter than those of the gloomy Scotsman? Here are some of the latest utterings of the chief among

them—"Loss of life!" exclaims Mr. Ruskin, cheerfully. "By the ship overwhelmed in the river, shattered on the sea; by the mine's blast, the earthquake's burial—you mourn for the multitude slain. You cheer the lifeboat's crew; you hear with praise and joy the rescue of one still breathing body more at the pit's mouth; and all the while, for one soul that is saved from the momentary passing away (according to your creed to be with its God), the lost souls yet locked in their polluted flesh, haunt, with worse than ghosts, the shadows of your churches and the corners of your streets; and your weary children watch, with no memory of Jerusalem, and no hope of return from *their* captivity, the weltering to the sea of your Waters of Babylon." *Oh! Goroo! Goroo-oo!*

Any philosophy which hopes for other than misery and disgust in life, must indeed seem strange doctrine to teachers such as these,—even as the smiles of the cheerful seem unmeaning and offensive to those whose souls are overcast with gloom and discontent. Sir Walter Scott tells a story of his childhood which well illustrates the unreasoning hatred felt by the Everlasting Growl school for the doctrine that conduct should be directed to the increase of happiness. One day, his healthy young appetite made him enjoy very heartily the brose or porridge of the family breakfast. Unluckily he was tempted to say aloud how good he found his food. His father at once ordered a pint of cold water to be thrown in, to spoil the taste of it! Possibly he meant to inculcate what he regarded as a high moral habit; but rather more probably Mr. Walter Scott, sen., objected to his son's enjoying what he had no taste for himself. Much of the sourness of the Growl Philosophy may be thus interpreted.

(*To be continued.*)

THE SUN'S DISTANCE.*

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

(*Continued from page 257.*)

THE most celebrated method of measuring the distance from the earth to the sun is without doubt that which is afforded by the transit of Venus. This has engrossed more than all the other methods together. On four occasions the attempt has been made to find the sun's distance by its aid; the last of these occurred only last December, and another opportunity will not occur until June in 2,004. It was formerly supposed, and it is, no doubt, still maintained by many, that the transit of Venus is *par excellence* the method, but the growth of practical astronomy has tended to question the supremacy of the transit of Venus. An attack has been made in two distinct directions. It has on the one hand been shown that the transit of Venus is incapable of the accuracy that was at one time claimed for it. On the other hand the new method by the aid of the minor planets has arisen.

The recent transit of Venus was observed in this country. It was on December 6 last, late in the afternoon, that the memorable event took place. The weather, it may be remembered, was in most places very unfavourable. A heavy snowstorm prevailed over a great part of the country. At Dunsink Observatory, Dublin, where I reside, a more unfavourable morning could not well have been conceived. The snow was falling, the clouds were thick, and there did not seem to be the slightest chance that anything could be seen. The day before was tolerably fine, and we had a sort of rehearsal of the observations to be made. The large equatorial was directed to the sun, and it was followed to the horizon. As the sunset approached the sun passed behind a tree and could not be seen. This was one use of the rehearsal; it showed that the tree was an obstacle. I pointed this out to the kind neighbour in whose grounds the tree was placed, and next morning the top was cut off.

On the eventful day, and up to about half-an-hour before the commencement, there did not seem to be a chance that any observations would be obtained, but we placed everything in readiness as if the day had been perfect. Just before the critical moment the snow ceased, the clouds began to break, and though the commencement was missed, I enjoyed a beautiful glimpse of the planet when its disc had about half entered on the face of the sun. It was, however, but little more than a glimpse, for the clouds again gathered and the snow descended, giving me for a few moments an exquisitely beautiful telescopic picture of a snowstorm, with the sun's disc as a background. For an hour nothing could be seen. Then again the clouds opened and disclosed what I can only describe as a most beautiful and striking picture. The sun had commenced to put on the ruddy hues of sunset. Its disc was streaked with bands of clouds, and far in on the surface hung the dark body of the planet. It was one of those rare sights which once seen can never be forgotten.

Good fortune has generally attended the expeditions which last December were scattered far and wide over the earth to observe the transit of Venus. A map is prepared to indicate the various regions in which the different phases of the transit were visible. The British Isles are seen just to fall into the region in which the commencement of the transit is visible. In the eastern parts of Europe and the whole of Asia the entire is invisible. The western hemisphere contains more favoured regions. The most glorious views of the transit of Venus were those obtained in America. In the centre of the region where the whole transit is visible lies the splendid empire of Brazil. The only part of the American continent which was unfavourably situated was the British possessions at the North.

We cannot now enter into details as to the method by which the transit of Venus is used for the purpose of finding the sun's distance. Every book on astronomy contains a description of the process. It will be my duty to attempt to define the amount of accuracy of which the method is capable. The observations to be employed are chiefly those made when the planet and the sun are apparently in contact, and the value of the method mainly depends on the possibility of determining the time with precision at which the contact takes place.

It was at one time believed that exceptional accuracy was attainable in such observations. Experience has not shown that these expectations were well founded. Look, for example, at a photograph of the drawings made on the last occasion by one of the most skilful observers, Dr. Vogel. We have here six most beautiful views of the progress of Venus as it approached to the first internal contact. The two extreme observations are plain enough. At 3 h. 10·8 min. Venus had not entered on the face of the sun completely. At 3 h. 14·1 min. there can be no doubt that the critical moment had passed. There are four intermediate stages. The recorded time of contact is 3 h. 13 min. 15 sec., but there must be a latitude of many seconds in the attempt to define a moment so confused.

The chief reason of the difficulty arises from the sluggish motion of Venus. The problem is something like trying

* A discourse delivered at the second general meeting of the British Association at Southport.

to tell the time accurately on a watch which had no minute hand; but besides the difficulty from this cause there are other difficulties of a very special character. Venus is surrounded by an atmosphere. You see the atmosphere in the ring of light surrounding the planet in Vogel's picture. The sun's rays are refracted through this atmosphere, and they place the observer in a condition of very great embarrassment, for the edge of the sun is distorted at the moment of contact.

Another source of difficulty arises from the phenomenon known as irradiation. Venus is a black spot; the sun is of dazzling brilliancy. This contrast has the effect of making Venus smaller than it ought to appear. A white circle on a black ground appears to be larger than a black circle on a white ground, even though both may really be exactly the same size. The irregularities arising from this cause affect in a marked degree the observations of the transit of Venus. The difficulties may, to a certain extent, be removed by calling in the aid of photography. By photography, also, a large number of observations can be secured during the progress of the transit, and thus in some degree compensation is made for the rare occurrence of the phenomenon.

A grand effort has certainly been made by the British Government, under the skilful direction of Mr. Stone, to give the transit of Venus a fair trial. Expeditions were sent to the West Indies, to South Africa and Madagascar, to Australia, and to New Zealand. The expeditions were, on the whole, very fortunate so far as the weather was concerned, and no doubt an approximate value of the sun's distance will be the result. I do not, however, believe that the transit of Venus can be expected to give that distance accurately to one-thousandth part. It is impossible to define the contacts with the precision that would be required.

Asking and Answering.—Correspondents who are so kind as to interrogate me as to the origin of the expressions, "Cleanliness is next to Godliness," "A Skeleton in the Cupboard," "Pouring Oil on the Troubled Waters," "He has burnt his Bridges," and the like, are respectfully referred—(1) to Mr. Wheeler's "Familiar Allusions"; (2) to Dr. Cobham Brewer's "Dictionary of Phrase and Fable"; (3) to the same learned author's "Reader's Handbook"; (4) to Mr. Eliezer Edwards's "Words, Facts, and Phrases"; and, finally, to *Notes and Queries*. I have repeatedly hinted to my readers that my main business here below is to keep out of St. Pancras Workhouse; and to that Haven of Rest I should speedily be bound if I tried to answer even a twentieth part of the questions asked me, and which (my early education having been sadly neglected) I am wholly unable to solve.—G. A. Sala in the *Illustrated London News*.

The Telephones of the World.—According to a German statistical periodical, in the year 1882 telephones were in use in the whole world in 303 towns, the subscribers numbering 78,808. This number is divided as follows:—Europe, 161 towns with 30,066 subscribers; America, 126 towns, with 47,185; Asia, 7 towns, with 420; Australia, 5 towns, with 897; and Africa, 4 towns, with 240. The European towns having telephones are divided as follows among the different countries:—Great Britain, 75 towns, with 7,287 subscribers; Germany, 21 towns, and 3,613 subscribers; France, 18 towns, and 4,437 subscribers; and Italy, 13 towns, and 5,507 subscribers. There is, therefore, an average of 424 subscribers for every town in Italy, 247 in France, 172 in Germany, and only 97 in Great Britain. The United States has 112 towns with telephone stations, and 41,569 subscribers.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXII.

I NOW come to a very important constituent of animal food, although it is not contained in beef, mutton, pork, poultry, game, fish, or any other organised animal substance. It is not even proved satisfactorily to exist in the blood, although it is somehow obtained from the blood by special glands at certain periods. I refer to *casein*, the substantial basis of cheese, which, as everybody knows, is the consolidated curd of milk.

It is evident at once that casein must exist in two forms, the soluble and insoluble, so far as the common solvent, water, is concerned. It exists in the soluble form, and completely dissolved in milk, and insoluble in cheese. When precipitated in its insoluble or coagulated form as the curd of new milk it carries with it the fatty matter, or cream, and therefore, in order to study its properties in a state of purity, we must obtain it otherwise. This may be done by allowing the fat globules of the milk to float to the surface, and then remove them—*i.e.*, by separating the cream as by the ordinary dairy method. We thus obtain in the skimmed milk a solution of casein, but there still remains some of the fat. This may be removed by evaporating it down to solidity, and then dissolving out the fat by means of ether, which leaves the soluble casein behind. The adhering ether being evaporated, we have a fairly pure specimen of casein in its original or soluble form.

This, when dry, is an amber-coloured translucent substance, devoid of odour, and insipid. This insipidity and absence of odour of the pure and separated casein is noteworthy, as it is evidently the condition in which it exists in milk, but very different from that of the casein of cheese. My object in pointing this out is to show that in the course of the manufacture of cheese new properties are developed. Skim milk—a solution of casein—is tasteless and inodorous, while cheese, whether made from skimmed or whole milk, has a very decided flavour and odour.

If we now add some of our dry casein to water, it dissolves, forming a yellowish viscid fluid, which, on evaporation, becomes covered with a slight film of insoluble casein, which may be readily drawn off. Some of my readers will recognise in this description the resemblance of a now well-known domestic preparation of soluble casein, condensed milk, where it is mixed with much cream, and in the ordinary preparation also much sugar. The cream dilutes the yellowness, but does not quite mask it, and the viscidity is shown by the strings which follow the spoon when a spoonful is lifted. If a concentrated solution of pure casein is exposed to the air it rapidly putrefies, and passes through a series of changes that I must not tarry to describe, beyond stating that ammonia is given off, and some crystalline substances, such as *leucine*, *tyrosine*, &c., very interesting to the physiological chemist, but not important in the kitchen, are formed.

A solution of casein in water is not coagulated by boiling: it may be repeatedly evaporated to dryness and redissolved. Upon this depends the practicability of preserving milk by evaporating it down, or "condensing." This condensed milk, however, loses a little; its albumen is sacrificed, as everybody will understand who has dipped a spoon in freshly-boiled milk and observed the skin which the spoon removes from the surface. This is coagulated albumen.

If alcohol is added to a concentrated solution of casein in water, a pseudo-coagulation occurs; the casein is precipitated as a white substance like coagulated albumen, but if only a little alcohol is used, the solid may be redissolved

in water; if, however, it is thus treated with strong alcohol, the casein becomes difficult of solution, or even quite insoluble. Alcohol added to solid soluble casein renders it opaque, and gives it the appearance of coagulated albumen. The alcohol itself dissolves a little of this.

The characteristic coagulation of casein, or its conversion from the soluble to the insoluble form, is produced rather mysteriously by rennet. Acids precipitate it from an aqueous solution, producing an apparent coagulation, but it is not a true and complete coagulation like that effected by the rennet, for on neutralising the acid precipitant with an alkali or metallic oxide the casein again dissolves. Excepting in the cases of acetic and lactic acids (vinegar and the acid of sour milk), which precipitate pure casein, the acid precipitates appear to be a compound of casein with the acids, and the casein is set free in its original state when the acid goes over to the alkali or basic metallic oxide. The action of rennet in the coagulation of casein is still a chemical mystery, especially when we consider the smallness of the quantity of coagulating agent required for the rapid and complete conversion.

A calf has four stomachs, the fourth being that which corresponds to ours, both in structure and functions. It is lined with a membrane from which is secreted the gastric juice and other fluids concerned in effecting the conversion of food into chyme. A weak infusion made from a small piece of this "mucous membrane" will coagulate the casein of two or three thousand times its own quantity of milk, or the coagulation may be effected by placing a small piece of the stomach (usually salted and dried for the purpose) in the milk, and warming it for a few hours.

Many theoretical attempts have been made to explain this action of the rennet. Simon and Liebig supposed that it acts primarily as a ferment, converting the sugar of milk into lactic acid, and that this lactic acid coagulates the casein; but Selmi has shown that alkaline milk may be coagulated by rennet in the course of ten minutes, and that after the coagulation it still has an alkaline reaction. This is the case whether fresh naturally alkaline milk is used, or milk that has been artificially rendered alkaline by the addition of soda.

Casein, when thoroughly coagulated by rennet, then purified and dried, is a hard and yellowish horn-like substance. It softens and swells in water, but does not dissolve therein, nor in alcohol nor weak acids. Strong mineral acids decompose it. Alkalies dissolve it readily, and, if concentrated, decompose it on the application of heat. When moderately heated, it softens and may be drawn into threads, and becomes elastic; at a higher temperature it fuses, swells up, carbonises, and develops nearly the same products of distillation as the other protein compounds.

I have good and sufficient reasons for thus specifying the properties of this constituent of food. I regard it as the most important of all that I have to describe in connection with my subject — the science of cookery. It contains (as I shall presently show) more nutritious material than any other food that is ordinarily obtainable, and its cookery is singularly neglected, is practically an unknown art, especially in this country. We commonly eat it raw, although in its raw state it is peculiarly indigestible, and in the only cooked form familiarly known among us here, that of a Welsh rabbit, or rarebit, it is too often rendered still more indigestible, though this need not be the case.

Here, in this densely populated country, where we import so much of our food, cheese demands our most profound attention. The difficulties and cost of importing all kinds of meat, fish, and poultry are great, while cheese may be cheaply and deliberately brought to us from any part of the world where cows or goats can be fed, and it can be stored more readily and kept longer than other kinds of animal food. All that is required to render it, next to bread, the staple food of Britons is scientific cookery.

If I shall be able, in what is to follow, to impart to my fellow-countrymen, and more especially countrywomen, my own convictions concerning the cookability, and consequent improved digestibility, of cheese, these papers will have "done the State some service!"

A CORRESPONDENT sends from the "Casket of Literary Gems," Horace Smith's "Astronomical Alderman." The following lines may amuse some of our readers who have not seen the original.

> Then he began with mighty bonhomie
> To talk astronomy.
> "Sir," he exclaim'd between his bumpers,
> "Copernicus and Tycho Brahe,
> And all those chaps have had their day;
> They 've written monstrous lies, sir,—thumpers!
> Move round the sun?—it's talking treason;
> The earth stands still—it stands to reason.
> Round as a globe?—stuff—humbug—fable!
> It's a flat sphere, like this here table,
> And the sun overhangs this sphere,
> Ay—just like that there chandelier."
> "But," quoth his neighbour, "when the sun
> From East to West his course has run,
> How comes it that he shows his face
> Next morning in his former place?"
> "Ho! there's a pretty question, truly!"
> Replied our wight with an unruly
> Burst of laughter and delight,
> So much his triumph seem'd to please him;
> "Why, blockhead, he goes back at night,
> And that 's the reason no one sees him."

TRUTH STRANGER THAN FICTION.—A good joke is often spoilt by dwelling too long upon preliminaries, and we shall therefore avoid discursiveness. In these days of school-boards and science departments, of examinations and certificates, it is hard to realise the following:—The Electrical Power and Storage Company had occasion recently to lend a secondary battery charged and ready for use. For the carriage the railway authorities claimed 22s. 6d. The battery was used and returned, the railway authorities now claiming 17s. 6d. A remonstrance was made as to the excess of charge in one direction over that in the other, which was met by the reply: Oh! but the cells were fully charged going, and returned empty, hence the difference in the carriage.—*Electrician.*

TROUVÉ'S RHEOSTAT.—A very useful rheostat has been devised by M. Trouvé, the well-known Parisian inventor. It consists of a German silver spring enclosed in a nickel-plated tube, the spirals not being allowed to touch each other, and insulated from the tube by a pasteboard sheathing. Inside the spring is a rubbing contact formed of a metal rod split into four parts, like the split plugs of a resistance box. This rod is graduated in divisions. The current enters at one end of the spring, traverses it, the rubbing contact, and the graduated rod. When the rod is deeply inserted into the spiral coil, the current only traverses a few turns, and the resistance in circuit is very small; but when the rod is pulled out, the number of turns inserted is considerable. The divisions on the scale tell the number of turns in circuit. The device is employed by Trouvé in connection with his polyscopes to regulate the strength of current supplied by a small Planté accumulator. The plan of splitting the rubbing contact is worthy of attention by electricians.—*Engineering.*

MATHEMATICS OF THE IMAGINARY.

By Richard A. Proctor.

PROFESSOR CAYLEY, President of the British Association, has delivered to that body (for the first time in its history) an address devoted entirely to mathematics—first with regard to the development of the mathematical theories by which science has been advanced, secondly (and principally) with reference to the strange fancies about imaginary geometries and space of more than three dimensions on which some of the ablest mathematicians of our time have squandered their powers. Certain journals, not too celebrated for profundity, but rather known for the stupendous blunders about scientific matters into which they have occasionally fallen, find much to commend in the profundity of Professor Cayley's address. The British Association was established, they tell us, for the advancement, not for the popularisation of science, and therefore the mere fact that out of 2,000 persons who collected to hear Cayley's opening address not a hundred even knew what he was talking about, and of these not ten could follow his semi-metaphysical semi-transcendental reasoning, was not open to exception. Just here, without considering the very doubtful question, or rather the question not open to any sort of doubt, whether discussions about non-Euclidian geometry and dimensions outside length, breadth, and thickness, in space, tend very greatly to the advancement of science, I may note that whatever the purpose of the British Association itself, the annual meetings of the Association have for their object, distinctly and emphatically, the popularisation of science. They even cater for this object in ways which are little consistent in my opinion with the dignity of science. Excursions are good things in their way, but they certainly do not tend in any marked degree (at least as arranged by the authorities of the British Association) to advance scientific research. Evening assemblies, in which the local folk, mayor, aldermen, and common councilmen, with their wives and mothers, sisters, cousins and aunts, form a motley gathering, in company with professors and their kinsfolk, and many by no means scientific representatives of fogeydom, are not calculated to excite a very profound feeling of respect for science.

No one who has attended meetings of the British Association can have failed to notice how large a proportion of the Members and Associates know scarce anything about science. For such folk certainly a discourse on imaginary points in space was wanting in interest, to say the least. For my own part, I think all such discussions not only wanting in value, but mischievous. All the powers of mathematics as now developed, and as ever likely to be developed, are insufficient for the work we want mathematics to do for science; and yet some of the ablest professors of mathematics are not ashamed to waste their energies in mere dreaming, and wild and foolish dreaming at that.

What, after all, do these notions about non-Euclidian geometry and a fourth dimension in space, amount to? In mathematics we deal with conceptions, more or less illustrated by things within our experience and subject to observation. All our conceptions, and all our experiences so far as they can be pushed, agree in presenting certain doctrines to us as axiomatic. It is not supposed, nor even regarded as conceivable, by the mathematicians of the new school, that our conceptions respecting mathematical axioms will ever change, or our experiences be ever corrected by others inconsistent with these conceptions. Straight lines which diverge from a point we never can conceive as converging again, without losing their straightness, after reaching a certain remoteness from a point of divergence. Nor can we suppose or even imagine ("which is else") that were we only able to carry on two such lines far enough we should find—say somewhere about a billion times the distance of the remotest star seen by the great Rosse telescope—divergence beginning to be transformed into convergence. So of other axiomatic properties. We cannot conceive a fourth dimension in space besides length and breadth and depth: if we take any plane whatever in which to measure length and breadth, we cannot conceive that plane, while remaining plane, to fail to divide all space into two portions, one on one side of it the other on the other, and this being so we cannot conceive any point as existing outside the plane which has not a certain distance from the plane, a distance which we may call depth or height as the case may be. It would be absolutely essential to our conception of a fourth dimension in space that we *should* be able to conceive of such points. Go to, then, say the mathematicians of the fancifully useless school, since we cannot conceive diverging lines as meeting again let us *pretend* we can conceive them so doing, and make a new geometry based on such a conception (as Lobatschewsky has done); and since we cannot conceive a fourth dimension in space let us act as though we could, and try to find what would be the order of things in universes of four, five, six, or n dimensions. So long as we measure as we do measure, and conceive perfect measurement as simply the kind of measurement which we aim at but cannot attain, our geometry is such as Euclid and his fellows have dealt with. Let us therefore imagine another and entirely different state of things,—let us pretend that every measuring line we use varies in length according to the place in space where it is used, increasing it may be towards some central point where it becomes absolutely infinite though it was finite where we began to use it, or instead diminishing down to nothing at the centre, though it was originally not to be distinguished from a respectable foot-rule. Or instead suppose it of a certain definite length at the centre, but either increasing to infinity or diminishing to nothing at some given distance from the centre.

The folly of all this is manifest enough. It may suit mathematicians of a certain school to suppose that by talking about the inconceivable as if they could grasp and understand it, they convince the world of their profundity. But the world is not altogether wanting in common sense, not ready to sing in chorus about the professors of the unintelligible—

If that will not suit them which will very well suit "we,"
Why what very very wise wise men these wise wise men must be.

But is is not altogether upon the unwisdom of inconceivable mathematics that I would comment. There is a more serious aspect of the matter. Science wants for her advancement the assistance of all who are competent to work well in her service. In mathematical research, especially, science needs the help of every one of the few who can really advance our knowledge in that direction. Science, then, has just reason to be angry when those who are best able to assist in the development of mathematics waste their time and squander their power in attempting to discover what would be the state of things in a world where all things were unlike what we know and can alone conceive,—where things equal to the same thing were not equal to each other, where two and two made three or five, where two straight lines might enclose a space or many spaces, where lines and curves not intersecting in *our* world might have imaginary points of intersection, and where finally besides length and breadth and depth there might

be a fourth, or fifth, or sixth, or *n*th dimension. So long as their existence is past in the world we know of and not in the "limbo of imaginary intersections" of which they love to speak, our mathematicians might condescend to do what Newton, Lagrange and Laplace, Euler, Adams, Leverrier, and Delaunay, have done with zeal and fervour,—viz., to advance, as far as in them lies, the mathematics of actual relations. To do this well will tax all their powers.

Lead-Smelting in Cyprus.—The Cypriot peasant, when in pursuit of moufion, the wild sheep of the island, makes the slugs for his flint-gun in the forest in the following primitive manner:—He takes two solid pieces of the bark of *pinus maritimus*, one about 18 in. long and 4 in. wide, the other much smaller. In the first he cuts a straight groove, a foot long, and just large enough to hold a cedar pencil. This is his mould, which he places horizontally on the ground by filling the groove with water, and then propping the bark with stones until the water is level. The water he then throws away. In the smaller piece of bark he scoops out a round hole, about 3 in. across and an inch deep. This is his smelting-pot, or furnace, and he cuts a slot from the cavity at one side to "run" the lead through. Into this cavity he puts some bits of red cinder from his wood fire. Over them he puts a few ounces of small shot, and this, again, he covers up with more of the red coals. Then using his mouth as a bellows, he blows vigorously upon the mass (all the Cypriot shepherds have splendid lungs) until, in a very short time, the shot is melted. He then pours it into the mould (which has had time to dry), and so produces a foot-long pencil of lead. This he rolls between two flat stones until it is quite even. Next he cuts it into short bits, which he again rolls, with a circular motion, between the stones, and thus obtains about forty slugs, or little bullets, nearly as perfectly round as the buckshot of commerce.

Although boring for coal has been carried out in several places in China, and working has been attempted in some of these, there is only one colliery at present in complete working order in the Celestial Empire. This is at Kaiping not far from Pekin, the colliery plant of which has been illustrated in our pages. The coal is said to belong to the true carboniferous system, and the bed dips to the south some 45 degs., forming a large basin under the Gulf of Pechihli. No fear is entertained that the measures will run short. So far as has been ascertained, the coal-bearing stratum is about 1,000 ft., containing thirteen seams. During the winter months, 200 tons per day of the inferior kinds of coal can be sold to the natives in the vicinity, who use it for pottery, brick, and lime kilns; indeed, one of the most important results achieved by the opening of the colliery has been the revival of several industries in the vicinity which were languishing or extinct, on account of the surface coal of the district being mostly worked out, and the price of coal being too high to be used with profit. In connection with the colliery is a small railway, the only one in China. Its length is but six and a-half miles, and at the terminus the coal is placed in barges and carried down by canal. After a little opposition, the locomotives were allowed to run freely. But ironworks, which it was also intended to start, could not get over the superstitious opposition raised on the score of the proximity of the Imperial tombs, and the consequent geomantic disturbances caused by sinking shafts, &c. The iron ore is said to exist in enormous quantities, but it is not easy to work owing to the amount of silica present.—*Engineering*.

RICHTER'S DREAM.

I RECENTLY quoted De Quincey's version of Richter's Dream, as I am in the habit of reciting it at the close of my lectures on the "Star Depths" and on the "Birth and Death of Worlds." A correspondent has kindly sent me the following copy of De Quincey's translation of Richter's Dream (vol. 13), which is very different from the other, justifying fully, I think, the words with which I introduce Richter's Dream,—"as translated, or rather as transformed and purified by our own prose poet, De Quincey:—

DREAM UPON THE UNIVERSE.

I had been reading an excellent description of Krüger's upon the old vulgar error which regards the space from one earth and sun to another as empty. Our sun, together with all its planets, fills only the 31,419,460,000,000,000th part of the whole space between itself and the next solar body. Gracious heavens! thought I, in what an unfathomable abyss of emptiness were this universe swallowed up and lost, if all were void and utter vacuity except the few shining points of dust which we call a planetary system! To conceive of our earthly ocean as the abode of death, and essentially incapable of life, and of its populous islands as being no greater than snail-shells, would be a far less error in proportion to the compass of our planet than that which attributes emptiness to the great mundane spaces; and the error would be far less if the marine animals were to ascribe life and fulness exclusively to the sea, and to regard the atmospheric ocean above them as empty and untenanted. According to Herschel, the most remote of the galaxies which the telescope discovers lie at such a distance from us that their light, which reaches us at this day, must have set out on its journey two millions of years ago; and thus, by optical laws, it is possible that whole squadrons of the starry hosts may be now reaching us with their beams, which have themselves perished ages ago. Upon this scale of computation for the dimensions of the world, what heights and depths and breadths must there be in this universe—in comparison of which the positive universe would be itself a nihility were it crossed, pierced, and belted about by so illimitable a wilderness of nothing! But is it possible that any man can for a moment overlook those vast forces which must pervade these imaginary deserts with eternal surges of flux and reflux, to make the very paths to those distant starry coasts voyageable to our eyes? Can you lock up in a sun or in its planets their reciprocal forces of attraction? Does not the light stream through the immeasurable spaces between our earth and the nebula which is furthest removed from us? And in this stream of light there is as ample an existence of the positive, and as much a home for the abode of a spiritual world, as there is a dwelling-place for thy own spirit in the substance of the brain. To these and similar reflections succeeded the following dream:—

Methought my body sank down in ruins, and my inner form stepped out apparelled in light; and by my side there stood another form which resembled my own, except that it did not shine like mine, but lightened unceasingly. "Two thoughts," said the form, "are the wings with which I move: the thought of *Here* and the thought of *There*. And, behold! I am yonder," pointing to a distant world. "Come, then, and wait on me with thy thoughts and with thy flight, that I may show to thee the universe under a veil." And I flew along with the Form. In a moment our earth fell back, behind our consuming light, into an abyss of distance; a faint gleam only was reflected from the summit of the

Cordilleras, and a few moments more reduced the sun to a little star, and soon there remained nothing visible of our system except a comet, which was travelling from our sun with angelic speed in the direction of Sirius. Our flight now carried us so rapidly through the flocks of solar bodies—flocks past counting unless to their heavenly Shepherd—that scarcely could they expand themselves before us into the magnitude of moons, before they sank behind us into pale nebular gleams; and their planetary earths could not reveal themselves for a moment to the transcendent rapidity of our course. At length Sirius and all the brotherhood of our constellations and the galaxy of our heavens stood far below our feet as a little nebula amongst other yet more distant nebulæ. Thus we flew on through the starry wildernesses; one heaven after another unfurled its immeasurable banners before us, and then rolled up behind us; galaxy behind galaxy towered up into solemn altitudes before which the spirit shuddered; and they stood in long array through which the Infinite Being might pass in progress. Sometimes the form that lightened would out-fly my weary thoughts; and then it would be seen far off before me like a coruscation among the stars, till suddenly I thought again to myself the thoughts of *There*, and then I was at its side. But, as we were thus swallowed up by one abyss of stars after another, and the heavens above our eyes were not emptier; neither were the heavens below them fuller, and as suns without intermission fell into the solar ocean like water-spouts of a storm which fall into the ocean of waters; then at length the human heart within me was overburdened and weary and yearned after some narrow cell or quiet oratory in this metropolitan cathedral of the universe. And I said to the Form at my side, "Oh, Spirit! has then this universe no end?" and the Form answered, and said, "Lo! it has no beginning."

Suddenly, however, the heavens above us appeared to be emptied, and not a star was seen to twinkle in the mighty abyss; no gleam of light to break the unity of the infinite darkness. The starry hosts behind us had all contracted into an obscure nebula; and, at length, *that* also had vanished. And I thought to myself, "At last the universe has ended," and I trembled at the thought of the illimitable dungeon of pure, pure darkness which here began to imprison the creation; I shuddered at the dead sea of nothing, in whose unfathomable zone of blackness the jewel of the glittering universe seemed to be set and buried for ever; and through the night in which we moved I saw the Form which still lightened as before, but left all around it unilluminated. Then the Form said to me in my anguish—"Oh! creature of little faith! Look up! the most ancient light is coming!" I looked, and in a moment came a twilight—in the twinkling of an eye a galaxy—and then with a choral burst rushed in all the company of stars. For centuries grey with age, for millennia hoary with antiquity, had the starry light been on its road to us; and, at length, out of heights inaccessible to thought, it had reached us. Now, then, as through some renovated century, we flew through new cycles of heavens. At length again came a starless interval; and far longer it endured, before the beams of a starry host again had reached us.

As we thus advanced for ever through an interchange of nights and solar heavens, and as the interval grew still longer and longer before the last heaven we had quitted contracted to a point, all at once we issued suddenly from the middle of thickest night into an aurora borealis, the herald of an expiring world, and we found throughout this cycle of solar systems that a day of judgment had indeed arrived. The suns had sickened, and the planets were heaving, rocking, yawning in convulsions. The subterraneous waters of the great deeps were breaking up, and lightnings that were ten diameters of a world in length ran along, from east to west, from Zenith to Nadir; and here and there, where a sun should have been, we saw instead, through the misty vapour, a gloomy, ashen, leaden corpse of a solar body that sucked in flames from the perishing world, but gave out neither light nor heat; and as I saw, through a vista that had no end, mountain towering above mountain, and piled up with what seemed glittering snow from the conflict of solar planetary bodies; then my spirit bent under the load of the universe, and I said to the Form, "Rest, rest, and lead me no farther; I am too solitary in the creation itself, and in its deserts yet more so; the full world is great, but the empty world is greater, and with the universe increase its Zaarahs."

Then the Form touched me like the flowing of a breath, and spoke more gently than before: "In the presence of God there is no emptiness; above, below, between, and round about the stars, in the darkness and in the light, dwelleth the true and very Universe, the sum and foundation of all that is. But thy spirit can bear only earthly images of the unearthly; now, then, I cleanse thy sight with euphrasy; look forth, and behold the images." Immediately my eyes were opened, and I looked, and I saw, as it were, an interminable sea of light—sea immeasurable, sea unfathomable, sea without a shore. All spaces between all heavens were filled with happiest light; and there was a thundering of floods; and there were seas above the seas, and seas below the seas; and I saw all the trackless regions that we had voyaged over; and my eye comprehended the farthest and the nearest; and darkness had become light, and the light darkness; for the deserts and wastes of the creation were now filled with the sea of light, and in this sea the suns floated like ash-grey blossoms, and the planets like black grains of seed. Then my heart comprehended that immortality dwelled in the spaces between the worlds, and death only amongst the worlds. Upon all the suns there walked upright shadows in the form of men; but they were glorified when they quitted these perishable worlds, and when they sank into the sea of light; and the murky planets, I perceived, were but cradles for the infant spirits of the universe of light. In the Zaarahs of the creation I saw—I heard—I felt—the glittering—the echoing—the breathing of life and creative power. The suns were but as spinning-wheels, the planets no more than weavers' shuttles, in relation to the infinite web which composes the veil of Isis ["I am whatsoever is—whatsoever has been—whatsoever shall be; and the veil which is over my countenance no mortal hand has ever raised"]; which veil is hung over the whole creation, and lengthens as any finite being attempts to raise it. And in sight of this immeasurability of life, no sadness could endure, but only joy that knew no limit, and happy prayers.

But in the midst of this great vision of the universe the Form that lightened eternally had become invisible, or had vanished to its home in the unseen world of spirits. I was left alone in the centre of a universe of life, and I yearned after some sympathising being. Suddenly from the starry deeps there came floating through the ocean of light a planetary body, and upon it there stood a woman whose face was as the face of a Madonna, and by her side there stood a Child, whose countenance varied not, neither was it magnified as he drew nearer. This child was a King, for I saw that he had a crown upon his head, but the crown was a crown of thorns. Then also I perceived that the planetary body was our unhappy earth, and, as the earth drew near, this Child, who had come forth from the

starry deeps to comfort me, threw upon me a look of gentlest pity and of unutterable love, so that in my heart I had a sudden rapture of joy such as passes all understanding, and I awoke in the tumult of my happiness.

I awoke: but my happiness survived my dream; and I exclaimed: Oh! how beautiful is death, seeing that we die in a world of life and of creation without end! and I blessed God for my life upon earth, but much more for the life in those unseen depths of the universe which are emptied of all but the Supreme Reality, and where no earthly life nor perishable hope can enter.

THE RING OF SMALL PLANETS.

By Richard A. Proctor.

OLBERS'S theory or suggestion that the four small planets Ceres, Pallas, Juno, and Vesta were the fragments of a single planet which had burst, was not hopelessly untenable; for the mean distances of these four planets are nearly equal, being 2·769, 2·771, 2·668, and 2·361 respectively, the earth's distance being unity. Indeed when Olbers first suggested the theory, only two of the small planets had been discovered, Ceres and Pallas, and these travel at almost the same mean distance from the sun. In the *Connaissance des Temps* for 1814, Laplace showed that with a velocity of explosion not exceeding twenty times that of a cannon-ball, say twelve times that of a ball fired from one of our best modern cannon, the observed range in the mean distances of these bodies might have been obtained. It is, however, to be noticed that even for this the Pallas fragment was assumed to have been expelled directly forwards and the Vesta fragment directly backwards (with reference to the course of the planet at the moment of the catastrophe, in order that the whole effect of the change of velocity might fall on the period, lengthening to the utmost that of Pallas and shortening to the utmost that of Vesta. If the picture illustrating this article is examined, it will be seen that the range in the known mean distances of the asteroids has enormously increased since then, and that even in this aspect alone the explosion theory is no longer so hopeful as when Laplace held it to be barely tenable.

But another objection, first dealt with by Encke, has always been held more serious, and has now become to all intents overwhelming. It was seen by Olbers and his contemporaries that whenever such an explosion occurred the new orbits of the scattered fragments must pass through the point where the explosion took place. They found no such point common to the orbits of the four first-discovered asteroids. Professor Newcomb says it is curious that they expected to find a region of intersection, as it implied (meaning that their intersection implied) that the explosion had occurred within a few thousand years. It would have been curious, however, if in Olbers's time men had expected anything else. However, whatever their expectations may have been, it is certain they found no such region of intersection. Encke showed even that, judging from the present variations of the orbits of the asteroids there was less approach towards a region of common intersection in past ages than there is at present. But a more careful investigation of certain of the asteroidal orbits has shown that, apart from the attraction of the small planets on each other, the orbits examined never *could* have intersected. And as the attractions of these planets on each other are exceedingly small it is practically impossible that the divergence of the system from a state of things which *must* have existed if ever a planet burst in the mid-region between Jupiter and Saturn, can be explained in this way.

Hence, as Professor Newcomb rather abruptly puts it, "Olbers's hypothesis is no longer considered by astronomers."

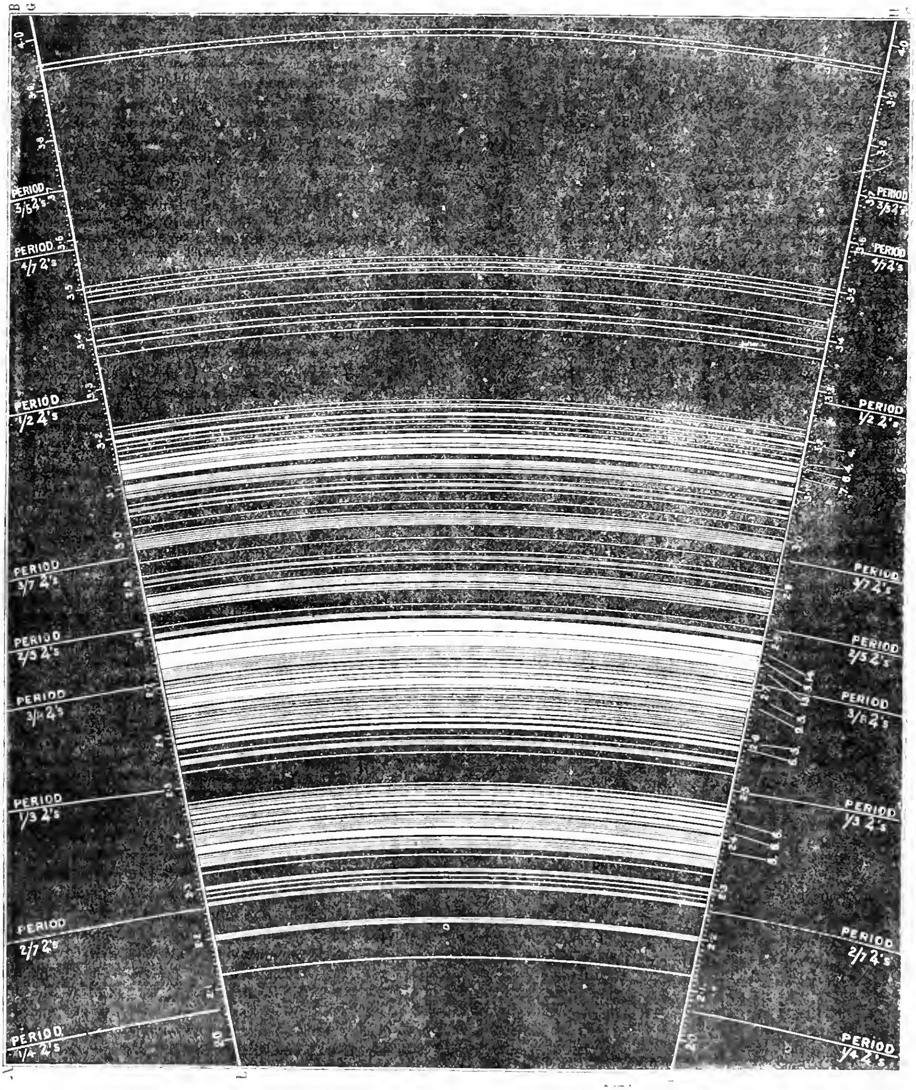
The physical objection to the theory lies in the circumstance that though in a great volcanic outburst the earth's internal forces suffice to eject matter with velocities comparable with those required by the hypothesis, we have in these cases the energies of enormous subterranean regions exerted on relatively minute bodies. To conceive that the energies even of the whole earth, if all brought into action at once, could suffice to propel the whole mass of the earth—in fragments—from around the centre of explosion, with velocities enormously exceeding those ever observed in any fragment ever shot out from a volcanic crater, is a very different matter indeed. A certain charge of gunpowder will drive a cannon-ball to a distance of two or three miles, but a thousand times that charge would not scatter the fragments of the cannon (if the ball had been tightly fixed in) over a similar distance all around the place of explosion. Nothing known about our earth's interior, nothing which we can infer about the interior of any other planet formed by processes such as we recognise in the development of the solar system as at present understood, suggests the possibility that a millionth part of the force necessary to shatter a planet, as Olbers's theory requires, can ever be generated and accumulated within the planet's interior.

But while the nebular theory gives a sufficient explanation of the existence of a zone of small planets instead of a single planet, this theory associated with the theory of meteoric aggregation which recent discoveries have established, gives also an account of the position of the zone of asteroids in the solar system and also of certain peculiarities which it presents under careful scrutiny.

On the former points I shall make some remarks next week, endeavouring to show that the zone of asteroids belongs to the region separating the sun's special family of small planets, from the region where orbs which not so very long ago were minor suns travelled with their attendant families of worlds.

For the present I note only the significance of that strange feature which Professor Daniel Kirkwood of Bloomington, Ind., was the first to indicate,—the gaps in the asteroidal system at those mean distances for which the attraction of Jupiter would have been most effective—in past ages—in disturbing the movements of meteoric or nebulous matter. It is well known that when two bodies travel around a centre in commensurable periods, the perturbations which with incommensurable periods would be ineffective in long periods of time, become very effective, especially if the periods are so related that a few circuits renew the disturbing influences. We see this in the case of Saturn and Jupiter, where two revolutions of the outer planet are accomplished in nearly the same time as five revolutions of the inner; hence arising the Great Inequality or Irregularity. The smaller body is the one always which is most disturbed. A vaporous or meteoric mass moving in a period similarly synchronising with Jupiter's would be very much more disturbed than a larger one, for precisely the same reason that (for instance) the moon's departures from the common centre of gravity of herself and the earth are much greater than the earth's. Such a mass would be driven to one side or the other of its original track until it would probably come into collision with one moving in a longer or a shorter

period; and so that particular case of synchronism would be eliminated. In millions, or perhaps tens or hundreds of millions of years, nearly all cases of synchronism would in that way be eliminated.



PATHS OF THE ASTEROIDS,

Distributed according to their Mean Distances, showing the gaps at those distances where the Periods of Revolution would synchronise with Jupiter's.

Whether such a process has been at work or not in the asteroidal system let the illustrative picture show, where the distances at which asteroidal movement would synchronise with Jupiter's in various simple ways, are indicated, and also all the asteroidal mean distances at present known. When Professor Kirkwood first noticed the peculiarity, not half as many asteroids had been discovered. Yet still, as more and more are found, the law is more and more clearly indicated.

(To be continued.)

Editorial Gossip.

It would not be right to pass without a word of recognition the very kindly greeting given me in Plymouth during the last three weeks, where crowded audiences met to hear each of my six lectures, giving me also the greatest compliment a lecturer can have—constant attention—though owing to the great size of the Guildhall and some slight acoustical difficulties the lectures were not given under quite the conditions that (for my audiences' sake) I prefer.

One hears with regret of the difficulties under which Mr. Matthew Arnold gave his first lecture in America. Want of practice in public speaking, and perhaps some vocal weakness, must be assigned as the reasons why Mr. Arnold was not heard throughout Chickering Hall; for the acoustical properties of that hall are almost perfect. During my four visits to New York, I have lectured in Chickering Hall ten times, in Association Hall eight times, and in Steinway Hall (which seats 2,000) twelve times. All three are good; but Chickering Hall is the best. How reading instead of speaking may affect the sound of the voice there, I cannot say, as I have never read during my lectures; but I should suppose no one who really wished to influence his audience actually reads: he may refresh his memory by an occasional look at his MS., but not read word for word from it.

New York while accepting English judgment as of weight in literature, regards it—according to the *Tribune*—as absolutely without weight in art. Hence after their first few nights, Mr. Irving and his company have had to rely on their qualities rather than on the credit they have attained at home. It is not altogether surprising that, thus tried, Mr. Irving has not at once leapt into favour in America. For there is much in his acting to mar the effect and influence of his real merits. But in the long run—though the attendance has for awhile thinned—his sterling good qualities must tell. As to Miss Terry's success in America there can be no doubt.

In answer to several correspondents I note that my lectures at the Kensington Town Hall, on Monday, Wednesday, and Friday next, will begin at eight. I trust all who can will be in their seats at that hour. A lecturer is sometimes blamed for waiting a few minutes when part of the audience is still coming in at the announced lecture hour. It *does* seem unfair to those who are there in time. But it is not in reality his fault. If he begins while still there is the sound of entering footsteps, he is not properly heard; and therefore in the interests of his audience he is bound to wait a little. But it is not fair on the part of those who come late (at least if they can help coming late—as they generally can) that the rest of the audience and the lecturer should be put to inconvenience.

The first lecture, on the Birth and Death of Worlds, will close with De Quincey's version of Richter's Dream. De Quincey's translation of that Dream (a very different matter), is given this week for comparison. The second lecture, on the Sun, will close with Vega's Poem which appeared in Knowledge for October 12, No. 102. The third and last lecture, on the Moon, will close with Anster's singularly fine translation of a famous passage in Goethe's Faust, beginning

See! all things with each other blending, &c.

Considering the recent attempt to kill and maim many British folk in the Underground Railway, it is a curious question—let the miscreants who made the attempt be who they may—whether a theory of evolution associating man closely by kinship of blood with the most hateful of the brute creation, would not be a relief from the thought that those wretches are akin to us.

THE FACE OF THE SKY.

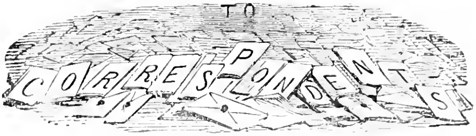
From Nov. 9 to Nov. 23.

By F.R.A.S.

The student will not fail to point his telescope to the sun on every clear day. Map XI. of "The Stars in their Seasons" shows the stars at present visible in the night sky. Mercury is now moving rapidly behind the sun, and is, for the observer's purpose, invisible. Venus is practically invisible, too, from her great south declination. Mars does not rise until between 9 and 10 o'clock at night, but, of course, does so sooner every day. He is still only fairly observable in a powerful telescope. Jupiter does not south until the morning hours, but he is some 23° high at midnight to-night, and 8° or 9° higher at the same hour by the 23rd. His place in the sky varies but little from that described a fortnight ago on p. 261. The phenomena of his satellites visible before 1 a.m. during the next fourteen days are as follow. On November 12 Satellite III. will pass off his disc at 11h. 14m. p.m. On the 14th the shadow of Satellite I. will enter on his face at 11h. 56m. p.m. On the 15th the same phenomena will occur with the shadow of Satellite II. at 11h. 28m. p.m.; 40 minutes after midnight, Satellite I. will reappear from occultation behind Jupiter's disc. Satellite I. will begin its transit over Jupiter on the 16th at 9h. 57m. p.m, and the shadow of Satellite IV. enters on to his limb at 12h. 1m. p.m. On the 17th Satellite II. will reappear from occultation at 11h. 39m. p.m. The shadow of Satellite III. will enter on to the face of the planet at 10h. 9m. on the night of the 19th, and will be followed by Satellite III. itself at 11h. 24m. On the 22nd Satellite I. will disappear in eclipse at 11h. 3m. 37s. p.m. Lastly, the shadow of Satellite I. will leave Jupiter's disc at 10h. 38m. p.m. on Nov. 23, to be followed by the Satellite casting it at 11h. 47m. p.m. Saturn is above the horizon during the greater part of the night, rising as he does by the 23rd of the month about 22 minutes past four in the afternoon. He is still above Aldebaran. He is an all-repaying object just now, even in the most moderate telescope. Uranus continues invisible, but Neptune, as we have so often said lately, may be picked up as a small 7th mag. star in that blank part of the sky south-east of δ Arietis. The Comet discovered by Pons in July, 1812, and rediscovered in America by Brooks on September 2 of the present year, is now visible, with but small optical aid, in the constellation Draco. During the period covered by these notes, it will describe an arc very rudely parallel with a line joining β and γ Draconis ("The Stars in their Seasons," Map XI.). On the night of November 9, the Comet will be found less than 1° south and a little to the west of β; and some 1° 40′ due south of that star on the 11th. It will be situated about 2° south of γ Draconis on the 20th. From these data, its path may be laid down on the map with sufficient accuracy to enable the observer to fish for it in the sky. As yet, it has developed no proper tail, so-called, in any moderate-sized instrument; but presents the appearance of a minute stellar nucleus surrounded by a diffused nebulosity.

The Moon's age at noon to-day is 9·5 days, and quite evidently will be 23·5 days at the same hour on Nov. 23. She will be fairly well placed for the observer during the greater part of the next fourteen days. During that period two occultations of stars only occur before midnight. The first is that of the 6th mag. star B.A.C. 1119, which will disappear at the Moon's bright limb at 8h. 12m. p.m. on Nov. 11., at an angle from her vertex of 29°, and will reappear from behind her dark limb at 9h. 2m. p.m. at a vertical angle of 287°. The second one is an occultation of A^2 Cancri, a 6th mag. star, which on the night of the 19th will disappear at the Moon's bright limb at 11h. 24m. at a vertical angle of 66°, to reappear at her dark limb at 12h. 19m. at an angle from her vertex of 191°. The Moon is travelling across Aquarius to-day and to-night, but about 3 o'clock to-morrow morning will cross the

boundary into Pisces. She will take 72 hours to pass through this great constellation; in other words, it will be 3 a.m. on the 13th ere she quits it for Aries. She will have traversed Aries by 4 o'clock in the afternoon of the 14th, when she passes into Taurus. Here she remains until midnight on the 16th, when she enters the extreme northern part of Orion. It takes her until 11 a.m. on the 17th to traverse this, and she then emerges into Gemini. Her path over Gemini occupies her until 2 a.m. on the 19th to describe. At this hour she enters Cancer. By 5 o'clock in the afternoon of the 20th she has quitted Cancer for Leo. She descends in Sextans about 3 p.m. on the 21st. At 2 p.m. the next day she re-enters Leo, and it takes her until 4 p.m. on the 23rd to travel over the remaining part of this constellation. At the time mentioned she passes into Virgo. We there leave her.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

THE GREEN SUN IN INDIA.

[992]—I last evening received a letter from a gentleman residing at Trichinopoly, dated Oct. 2. It may be interesting, perhaps helpful.

"There has been a very curious phenomenon seen the last three weeks or so in the rising and setting sun. It presents for a time after rising a light green appearance, and again the same colour a little time before setting. It is very curious to see its colour on the walls of my bed-room of a morning. The natives are in great dread, fearing it portends some great calamity." S. NEEDHAM.

[The length of time named is remarkable.—R. P.]

A CURIOUS PHENOMENON.

[993]—I have just seen Mr. Noble's letter in No. 98 of KNOWLEDGE, describing a comet-like appearance in the Eastern horizon before the rising of the moon.

A similar cone of light to that represented in his sketch—with the exception that the tail was broader and not so long, and the lines of cloud were nearer the horizon—was witnessed here by myself and several others one evening in July, about 7.30 p.m. Thinking it might be the tail of a comet, I went into the house to prepare my telescope, with a view of directing it upon the nucleus directly it arose, but, while thus engaged, the whole faded away.

It was as nearly as possible E.S.E. over the Karwendel range of mountains, and could not have been caused by light from a town or furnace, there being nothing of the sort for miles and miles. The moon rose about the same spot rather more than an hour afterwards. M. F. W.

[994]—With reference to the paragraph in KNOWLEDGE, numbered 826, and headed "A Curious Phenomenon," I have a few remarks to make. It is generally known that lightning presents itself in various forms, sometimes as sheet lightning, sometimes as forked lightning, and sometimes, but more rarely, as earth lightning. This earth lightning, instead of dropping from the sky, rises from the ground, taking sometimes the form of a fiery globe, and sometimes that of a fiery pillar. I have now before me an account of one of these fiery globes which struck a nunnery at Bologna, and which emerged from a large hole into which the street water emptied, finally expending its fury by knocking down a portion of a tower.

I would suggest that it was a phenomenon of this nature that was witnessed by Mr. Noble on the 28th of last month, and respecting which he solicited explanations from the readers of KNOWLEDGE. I may add that many years ago my wife saw a precisely similar exhibition to the one depicted in Captain Noble's sketch, when walking one evening in the fields in a rural district in the west of France, many miles away from any town or even village. She says the sketch given in KNOWLEDGE represents what she saw on the above occasion as perfectly as if she had drawn it herself. I myself, about fifteen years ago, whilst driving one evening in a country district a few miles north of Bolton, in Lancashire, saw three pillars of fire rise out of the earth within a few yards from my phaeton. The first pillar rose on my left-hand side; then, after I had proceeded about a quarter of a mile, a second pillar rose on the right-hand side; and the third one appeared at the junction of two roads a few hundred yards further on. These fiery pillars seemed to be, as far I can recollect, about twelve feet high, and in circumference about the same as the funnel of a large steamer. My groom, who sat beside me, saw these appearances as distinctly as I did myself, and the same may be asserted with respect to my horse, which was so terribly frightened that it required all the restraints possible of reins, and soothing persuasion of voice, to keep him from bolting off in a frantic gallop. G. M.

[Arago cites many cases of globe-lightning; but "G. M." scarcely makes out the connection between the phenomena described by Captain Noble and what he witnessed himself. We have no evidence, by the way, that forked lightning drops from the sky.—R.P.]

BRILLIANT RAINBOW.

[995]—The most briliant rainbow I remember having ever noticed was visible from here (Peckham) on Oct. 21, at about 4 p.m. Both the primary and secondary bows were bright and, as far as the houses allowed them to be seen, complete. Inside the primary, and seeming to touch it, was a third bow, colours reversed, and very faint. This sight made me look into the theory, and I find that this faint bow is the sixth. The fifth, which should be between the first and second, was invisible, a circumstance of which an explanation would be welcome. V. COTTER.

NEW MOON ON SATURDAY—DAY OF WEEK.

[996]—That the writer of the "Companion to the Almanac" and the corrector of all paradoxes should himself make a slip when trying to excuse one of his *protégés*, shows only that he was human. The occurrence of new moon on Saturday, March 24, 1859, brought to light defenders of the old sayings about bad weather connected with Saturday's new moon and Sunday's full. To expose the want of evidence for these proverbs was not difficult for Professor de Morgan, but, in further speculating on the subject, he based an argument on the likelihood that the completion of the lunar cycle would bring back the Saturday's moon (see pp. 195 and 196, "Budget of Paradoxes"). Nineteen years later, found a new moon on the same date, but, alas! it was Tuesday, March 24, 1868, instead of Saturday.

To calculate mentally the day of the week for any given date is a species of number-conjuring more practically useful than some recently contributed to your pages.

The given date is analysed into four parts—(1) hundreds, (2) years (without the hundreds), (3) month, (4) day of month. Each one of these four parts contributes a week-day equation as follows:—Say for Sept. 13, 1883.

I. HUNDREDS.—Divide by 4, and subtract twice the remainder from 6.* 18÷4 leaves 2; twice 2 from 6 leaves 2.)

II. YEAR.—Divide by 4; and from twice the quotient subtract the remainder, and subtract what then remains from the nearest multiple of 7 (83÷4=20+3; twice 20−3=37; 37 from 42 leaves 5.

III. MONTH.—The equations for the successive months are:—1, 4, 4; 0, 2, 5; 0, 3, 6; 1, 4, 6. They can be committed to memory more easily by threes, calling them 12 squared, 5 squared, 6 squared, and 12 squared plus 2. (September=6.) If date is in January or February leap-year, subtract 1.

IV. The day of the month is its own equation (13).

These four equations of the day of week (2, 5, 6, and 13) are added together (26), divide by 7, and the remainder (5) is the day of week (Thursday). If 0 remains, it is Saturday. A rapid calculator can give the answer almost instantly.

J. GREEVES FISHER.

* This is the rule for New Style, which began on Thursday, Sept. 14, 1752. Old Style ended on Wednesday, Sept. 2, 1752. For Old Style dates add 3 to the hundreds, and subtract total from a multiple of 7.

MUD-GUARDS FOR TRICYCLES.

[997]—May a Tricyclist in difficulties turn to Knowledge and Mr. Browning? I believe in small wheels geared up, but they splash more than big ones at the same pace. I need to ride with a clean coat. Riding in a jacket with a light coat for calls or meetings will not always do, *e.g.* for dining out. My old "Excelsior" (wheels 20 in., 30 in., and 50 in. geared level) kept me fairly clean except in gales of wind, so long as I kept to five and a half or six miles an hour over the worst mud. A "Meteor Sociable" (40 in. level) plastered my arm a quarter-inch thick with mud the other day. Even the "Humber" pattern, which I like best, splashes me a little (44 in. level). I do not want to give up tricycling for the purposes of my daily work. Is there any help? D. M.

CHESTNUTS AND BEECHMAST.

[998]—In the case of strong trees, with plenty of light and air, both the chestnut and the beech are fertile in West Worcestershire and its neighbourhood, while the sterile husks are common where trees are crowded.

My father planted several chestnuts, as young trees, in 1845. Twenty years or so later the nuts on the "spotting" trees among these were as fine as the imported chestnuts of the shops, and were in great abundance. There was usually one nut squeezed up and empty in the husk, which contains three. I believe that these trees continue fertile. Older and sturdy beeches on the same land were also fertile. F. S. L.

BEECH MAST.

[999]—Mr. Grant Allen says in his latest chapter of the "Naturalist's Year" that in Britain the nut or mast of the beech is almost always sterile, and he emphasizes this by pointing out the correlative fact that the beech is in a decadent condition in this country. With all possible deference to this delightful writer, I beg to assert that, as a boy, I have eaten hundreds, perhaps thousands, of these nuts (their kernels I mean), and I can state positively that in Hampshire, and also in Oxfordshire, an enormous number of them come to perfection, *I should think one half*—though this estimate, I admit, is little more than a guess. At any rate it is not the fact, as least so far as the counties I have mentioned are concerned, that the "beechnuts or mast *rarely* contain a kernel." F. M. Duplock.

TOTAL ABSTINENCE.

[1000]—In your issue of Sept. 14th, p. 166, Mr. W. Mattieu Williams gives a thrust at the practice of totally abstaining from alcoholic drinks, or, perhaps, better at those who try to induce others to so abstain. He tells us that, after some days' privation from food of an agreeable kind, he came to a station at which he was able to obtain food to please him, and also *claret*. It is to the latter that we owe his experience. He tells us that the "*first* glass of claret produced an effect that alarmed me—a craving for more and for stronger drink that was almost irresistible." He then goes on to urge that food reformers might do more good than temperance reformers. Temperance reformers fully recognise the help that better food may yield them; but does it not occur to Mr. Williams that since the intense craving *followed* the consumption of the *first* glass that, if the first glass had not been taken, the craving would not have arisen? I fancy the main point with most total abstainers is, if you don't want the craving, don't excite it. I think our thanks are due to Mr. Williams for thus unknowingly affording us proof of the soundnes of our doctrine.

W. T. Postlethwaite.

INTERNAL PARASITES.

[1001]—Will you kindly allow me to inquire through the medium of your columns, for an explanation of certain discoveries I made one morning in a piece of cod's liver. On taking it up I observed several hard excrescences, and upon cutting them away was astonished to find a fine thread-like worm, curled up like the mainspring of a watch. Upon my separating them with great difficulty from the liver which they had almost become a part of, and putting them into a phial of water, they swam about with ease, and have lived for several hours, and, indeed, are alive at this present moment, although taken from a dead fish, which must have been so for twenty-four hours at least. I have also observed the same phenomenon in the livers of other animals, such as fowls, rabbits, &c., but did not experiment until now. I would gladly know if such parasitical livers are injurious if eaten by man. I would also like to know what those small star-like bones found only on the back of turbot are. Amy Briggs.

LETTERS RECEIVED AND SHORT ANSWERS.

Atom. If the sun is represented by a globe 2 ft. in diameter at your house in Sloane-street, and Neptune by a plum on Clapham, common, a globe 3½ ft. in diameter, at a distance of sixteen or seventeen thousand miles would be about right for the nearest star-and if the surface of this globe had the same intrinsic lustre as the sun's surface it would look like a star, of about the same brightness as Alpha Centauri. Where the globe should be fixed I cannot tell you. I said "*more* than 200,000 times the sun's distance"—about 210,000 time would be nearer the truth.—A Constant Reader, E. M. Dearman. Thanks; printer's error, I expect.—John H. Tyson. Do not the words "Unknown, yea evermore Unknowable" remove all the untruth of which you speak? Vega seems, like Darwin, to express—after some fluctuations—a feeling akin to that which underlies the higher Agnosticism. There is no more any actual assertion of doctrine than there is any deliberate statement on his part that the conversation described really took place. The whole thing is intended, I should imagine, by way rather of symbolisation than of description. It would, of conrse, be "caviare to the general."—Vanessa. The idea is excellent. Will submit it to F.R.A.S.—F. Ricardo. Thanks for the note, which shall appear as soon as possible. What an absurd thing is the common estimate of singers: A, with a pure and beautiful tenor voice (but ranging not higher perhaps than A natural), a true ear, and the power of throwing the right expression and as it were the true emotions into his vocalisation; B, with a voice strident if not absolutely harsh, an untrustworthy ear, and no power of expression whatever, capable of throwing neither softness nor fire into his singing, but able to strain out the Ut de Poitrine; yet B shall be regarded as a great tenor and A as but a second-rate singer.—P.S. There is no truth whatever in the notion that the sun puts out a fire, though there are many who "know" that the sun does so, and that a poker across the top bar makes a fire burn up.—H. A. Bulley. Letter marked for insertion.—F. W. Wooler. Know as yet nothing personally; may shortly do so.—Ignoramus. A comet is *always* more or less under the sun's influence. When nearer to him the comet has greater velocity, and therefore greater centrifugal tendency. At its nearest this tendency suffices to balance the tendency to approach, and thenceforward the comet recedes. See, however, for fuller explanation of elliptical motion my treatise on the Sun where this point is considered at some length.—A Lady Mathematician. You should rather say that Helmholtz conceived the possibility of some one conceiving straight lines which after diverging might begin to diverge. The papers you consider "rubbish" I find charming—so greatly do tastes differ. (This refers to one only of the writers you name. The other is too nearly related to myself for me to express an opinion.) Your letter *does* refer to *some* rubbish with which I will not fill my paper. "Even Hampden," as you say, "would be better than that."—T. B. Walker. Marked for insertion: though when there may be room, I cannot say.—Hallyards. Your talk about poetry not very instructive: most prosaic. But a Philistine is not expected to understand Gujerati.—C. E. Ranken. Membership of the British Association is secured by attending meetings and paying either the annual subscription of two guineas, or a life-subscription the amount of which is unknown to me.—S. S. McIlwraith. No answer which could be given here would be of service to you. The subject is too difficult to be dealt with in these pages.—Harry St. Excuse my omitting your exasperating and extra-aspirated joke. The papers on the spectroscope soon.—Berks, J. E. Lush. Regret that long experience forbids my giving such advice here.—S. Orr (?). I think the saying on Fitzroy's Barometer, "Sudden rise after low foretells strong blow," very unsatisfactory; but have not noticed that "sudden rise after low" is usually followed by rain; though it may be.—C. L. Sweedale. See note on subject.—Uncertain. You leave me more uncertain than ever. Who on earth knows? is really all I can say.—C. D. Term "range," as you suggest, quite unscientific.—H. Smith. Perhaps some correspondent may know how you should keep and feed chameleons through the winter.—Thos. Radmore. No space for your note. Probably your clock time was inexact.—Carlton. The idea of the "lost Pleiad" might be suggested to a child in these days as readily as to a race of men at any past time. For there is no reason to believe that the fainter seventh star ever was as bright as the others. Seven stars can be seen by eyes of certain degree of power, one of the stars being fainter than the others; what more natural to the fanciful mind of child-races, than the idea that that star had once been like the others but had lost its original lustre, especially if the stars had come early to be known as "the seven," which they would be very apt to be.—V. Cotter. Letter marked for insertion.—J. J. T. That result means simply that F for 150 lb. falling 9 ft., would be the same as for 38 tons with a velocity of 1 ft. per sec., which would be attained

after falling ⅞ths of an inch. The formula is correct.—H. C. STANDAGE. Can find no trace of the paper. Will make inquiries.——F. H. GLEW. It is not easy to determine the use of the instrument of which you send photograph. It seems intended, *inter alia*, for use in map projection. If I were more at home I would ask you to do what you suggest; but sending the instrument to me when I am so seldom in town would involve the risk of its being lost or injured in following me on my travels.—AN INVALID would like advice as to the most suitable tricycle for one suffering from chronic weak back, and unable to ride inclines with the tricycles usually to be hired.—MUFF. My opinions about the ancient Phœnicians would not be worth much.—A. ARCHER. Away from home] so cannot hunt up references. The article on "Lotteries" came out in the *Cornhill Magazine*, not in *Good Words*. It is republished in one of my volumes of "Essays." Forget which. Messrs. Chatto know.—ST. C. LUCAS. Fear no known vibrator, photographic plates, or selenium cells, would do what your plan would require,—in particular, the complicated vibrations of a diaphragm affected by the voice are not suitable.—D. MCCULLOCH. Could not venture advice on such a subject.—JOS. HORNER. Space considerations have caused delay. Hope to use the papers.—F. COWLEY. That is the right way to get the fourth decimal correct. On the other and more general question it is not possible to give advice. A simple treatise on geometrical conic sections would be good for you and interesting to you.—W. H. JONES. The difficulty is to get scientific evidence that spontaneous generation ever occurs; until this has been done we cannot discuss in a scientific way the possibility of spontaneous generation or the conditions suitable for its occurrence. Science can only keep on trying, and when it fails admit as much.—D. M. desires to know whence cats obtained (1) their ideas of medicine, and (2) their love of fish. He suggests that Egypt taught them both. *Quien sabe?*—F. JACKSON. Letter forwarded; one from another correspondent on same subject already in type.—F. THOMPSON. Pardon me, I am *not* "at length ready to enter into controversy with any rational advocate of the flat earth theory except Parallax and Mr. Hampden." *Imprimis*, I have never yet come across any rational advocate of the theory, and I cannot imagine the existence of one; then, if I had, though I should have been surprised, should have felt in no way interested to controvert views so absurd. I have never taken the least interest in the flat earth theory except for the evidence it gives of what some *can* believe. I offered to consider any difficulty and show where the explanation lay. But I did not offer to make my explanation such as would be understood by the person to whom it was proffered. One cannot get a quart into a wine-glass (not by a jugfull). Your difficulty that because a small hill will hide the lower parts of a distant object, therefore there is no force in the evidence derived from the sea hiding such parts of objects, is no difficulty at all. In each case something hides something else and is therefore between the eye and that something. The flat-earth folk try to make out that the sea is *not* really in the way. Your argument really asserts that it is. Then you say the earth's surface is represented correctly enough on flat maps. Try it. Show in a map the North Pole, the equator as a circle round it; and then—not troubling about filling in that circular space—show Australia, South America, and Africa outside the equatorial circle, with anything like the proper relative distances in a north-and-south and also in an east-and-west direction (distances determined by multitudinous measurings—even though here and there parts have escaped measurement) and it will be time to think about flattening the earth. Even then I should like to see your idea of the star-sphere, in which the groups of stars, always unchanging, fill the complete surface—leaving no room for anything but a spherical interior. Note also that at the equator, you have only to wait from sunset to the next sunrise to see the whole interior of that star-strewn sphere.—E. C. H. Glad to hear that Vega's lines as recited by me at the end of my Worthing lecture (the first time I so used them) pleased you so much. Vega will be pleased too.—H. E. M. When broken glass is joined by fusion, nothing I believe is put between them.—E. PRICE EDWARDS. Much obliged but no space.—MOLTO GRAZIE. Papers will be collected.—W. H. GOY. In the only case when I saw a "dancing sailor" there were fine threads. Should require to know more about the matter before I put it as an example of electrical action.—A. T. BIRCHAM. Thanks. Another note to same effect in type.—ED. LUXMORE. I agree with you. But the statement you object to was widely published and not contradicted. On the other subject, being twitted with burking controversy I thought it best to give due allowance of rope for self-hanging.—J. H. B. F.R.S.A. proposes to treat of that and similar simple telescope matters.—JAS. A. GEE. Shadow has not unfrequently been seen in fog and cloud. J. A. MCDERMOT. Know of no useful books on Heraldry.—J. K. R. Moves of Knight dealt with, I think, in a book by Walker: but question should have been addressed to Chess editor. The nines problem depends on the well-known one that if from a number you subtract the sum of its digits, the sum of the digits in the difference is a multiple of nine,—a property explained repeatedly.—PITT (1) Max Muller's date is far enough back to agree with my statement as to the high antiquity of the constellation figures. (2) As to spectrum analysis, I thought you referred to the evidence as to nature of substance not as to condition. On this last point it is likely enough we may have to modify our views.—C. L. LIVERDALE. Thanks: but have no other accounts with which to compare yours and so get actual path of the body.—A HOEDEN. Doubt if author of that sum could now be identified.—W. HAMPTON. Fancy I catch your drift: "I should smile to twitter."—CHAS. COOKE. Your "curious fact" amounts to the following formula:—

$$2x+(x-1)^2-1=x^2;\ \text{or}\ (x-1)^2=x^2-2x+1.$$

This is not, strictly speaking, a new property.—C. FEW. Rather more space than can be conveniently spared to show how by multiplying and adding large numbers you can get 1 followed by a number of zeros, and then removing 1 get *nothing*. I'C few, C. Few, 00. (U can,—doubt, I0 that). S.B. Thanks; but no space for attempts at spelling reform.—HAMILTON would like to be told some simple way of demonstrating the presence of sewer gas in the air, when denied by smell-wanting folk.—J. GUARDIA. Thanks. —RAPHAEL R. MAY. In England a billion means a million millions, or a million to second power, a trillion a million million millions, or a million to third power, and so on. In America and on the Continent the absurd system you mention is adopted, according to which no uniform explanation of the *bi-*, *tri-*, *quadri-*, &c., in these number names can be given.—R. C. SHETTLE. Thanks for paper on terrestrial magnetism.—A SUBSCRIBER. Cannot explain abnormal action of weather barometer.—VERMICULUS. Regret no space; pity you did not witness end of encounter.—E. H. Soon.—VIGNOLES. Have received no other observations of meteor with which to compare your very accurately and usefully rendered ones. —HEALTH. Do not know how light may be increased. Hair certainly weakened by wearing cap.—J. Y. Why certainly; if your watch is set right for Greenwich time and rightly rated, it will be 5 h. 35 m. wrong by New York time when you reach New York. What else would the difference of time between New York and Greenwich mean?

Our Whist Column.

BY "FIVE OF CLUBS."

ON SIGNALLING AT WHIST.

IN the Whist of our time there is a complete code of signals by which information as to the state of a player's hand may be conveyed to his partner, but at the same time to the adversaries. I have in former papers described these signals, though they are indeed well known to all Whist-players. I have also in some of the illustrative games which have appeared in these columns from time to time, shown how by means of these signals a player is often enabled to forward the development of his own and his partner's strategy. The Whist editor of the *Australasian* in a number which has just come to my hands points out with a good deal of truth that only the good effect of signalling is thus shown in illustrative games. In numbers of cases signalling, and even such conventional rules as returning the highest of two and the lowest of three or more, help the adversaries much more than the partner. The question hence arises whether even if signalling be not regarded as always dangerous and on the whole more apt to be mischievous than useful, it should not be much more cautiously adopted than Cavendish and other advocates of the system suggest. During the last two years I have paid a good deal of attention to this question, first brought to my notice by "Mogul" in those columns and I must confess that in a majority of games which I have analysed although signalling did not in every case (not more than about half) defeat the object of the signallers and help the adversaries it would have done so if the adversaries had taken due advantage of what they were told. Thus my observation though not enabling me to go quite as far as the Whist Editor of the *Australasian* in the following passage, points in the same direction:—

"Five of Clubs' illustration" (he is referring to a case in which we had shown how by departing from book-rules a game was saved, the departure arising from the adversaries' signals) suggests "the reflection that, by the adoption of the penultimate signal, a Whist-player may give his adversaries just the information in regard to the constituents of his hand which will indicate to them the lines on which to proceed if they wish to take the best chance of saving the game. This disadvantage is not peculiar to the penultimate

signal, but is inherent in all the modern conventions, including the call for trumps. We have said on a previous occasion that 'the main difficulty with which a common-sense Whist-player is confronted is how to give his partner enough of general information about the state of his hand without telling his adversaries too much.' But this is a problem, the very existence of which, as it seems to us, the modern petrolateur insists on ignoring. His doctrine is, not that it is the duty of a Whist player to tell the truth, and nothing but the truth; but that he shall tell the whole truth, with all possible detail, to partner and adversaries alike. In other words, by the use of conventional signals, he aims at assimilating the practice of Whist to the practice of double dummy. The result is that, when the combined hands are weak, he loses many a game which a common-sense Whist player would save; and that, over and over again, when the combined hands are strong, he just fails to win the game through giving the adversaries detailed information which he had far better keep to himself, and which is not in any degree essential to the effective combination of his own and his partner's cards. The illustrative hand from the *Field** indicates the danger that characterises the Whist of the conventional school. But the great majority of published examples of the petrolatic system are selected with the view of proving that the modern conventions are good: and, as a rule, little or no notice is taken of the numberless Whist hands in which the adversaries avail themselves of the information afforded by the signals to defeat the object of the signaller. Doubtless the advocates of the modern system are wise in their generation; but, despite their reticence, we have seen enough of the consequences of adopting their fads to feel justified both in forming and expressing an opinion as to their real value. That opinion is that the cases in which the conventional signals are of use are, generally speaking, just the cases in which the combined hands would work together effectively without their help. This, at all events, is the result of our personal experience, and hence we feel anxious that the Whist-players of Australia, for whom we write, should carefully consider the *pros* and *cons* of the matter before they decide on enrolling themselves as members of the coterie of which Cavendish is the recognised leader, and on accepting his later teachings as *bonâ-fide* improvements in Whist practice."

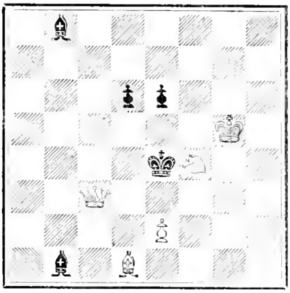
Our Chess Column.

By Mephisto.

PROBLEM No. 104.

By B. G. Laws.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Tournay Problems, p. 266 (No. 104).

(Hesperus.)

1. Kt to B3	K to Kt5, or	1.	K to Q5
2. Kt (K3) to Q5 (ch)	K to R4 or 6	2. Kt to B sq (ch)	K moves
3. B to Kt6, or Q to B sq, mate		Q mates accordingly	

* This hand, one of the most interesting we have ever seen, we shall give next week.

(Childe Harold.)

1. B to B5	K takes P, or	1.	K to B5
2. Kt to K3 (ch)	K takes B or K4	2. Kt to B2	K to B6 or K4
3. Q to Kt6 or B5, mates accordingly		3. Q to Kt 1 or Kt5, mates accordingly	

(Tendanda via est.)

1. Kt to B8	Kt to Q4, or	1.	K to K6
2. Q takes P (ch)	K to B5	2. B to R6 (ch)	K to K5
3. Kt to K6, mate		3. Q takes P, mate	

(Emu). (A Black Kt on K8.)	(Childe Harold.)
1. Q to B3, and mates accordingly	1. Q to K2, and mates accordingly

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Berrow.—Yes; in self or sui-mate Problems, White compels Black to mate White. Problems received with thanks; you will hear from us shortly. Solutions correct.

C. Planck.—Best thanks for Problem.

C. S. P. and P. C.—Received with thanks.

E. C., Rathmines.—Two-mover correctly solved.

Henry Bristow.—All the five solutions correct.

Problem No. 103.—Correctly solved by W. Furnival, Clarence, and W.

MR. R. A. PROCTOR'S COURSE OF LECTURES.

1. LIFE OF WORLDS.	4. THE PLANETS.
2. THE SUN.	5. COMETS.
3. THE MOON.	6. THE STAR DEPTHS.

See Advt. Pages for full Syllabus.

The following arrangements are complete: the numbers in brackets referring to above list.

Town Hall, Kensington, Nov. 12, 14, 16 (1, 2, 3).
Great Hall, Tunbridge Wells, Nov. 20, 22 (4, 5).
Concert Hall, Maidstone, Nov. 19, 21, 23 (1, 2, 3).
Stockton, Nov. 26 (1).
Edinburgh, Nov. 28 (6).
Rothesay, Nov. 29 (1)
Morningside, Dec. 4 (4).
Falkirk, Dec. 5 (6).
Alexandria, Dec. 6.
Altrincham, Dec. 10 and March 11.
Carlisle, Nov. 27, 30; Dec. 3, 7 (1, 2, 3, 4).
Perry Bar, Jan. 29 (6).
King's Heath, Jan. 30 (1).
Colston Hall, Bristol, Feb. 18, 21, 25, 28; March 3, 6 (the full course).
Assembly Rooms, Cheltenham, Feb. 5, 8, 12, 15 (1, 2, 4, 6). At 3 o'clock, Feb. 5 and 12 (3, 5).
Assembly Rooms, Bath. Four Morning Lectures at 3 o'clock, Feb. 6, 9, 13, 16 (1, 3, 4, 6); two Evening, Feb. 6, 13 (2, 5).
Birkenhead, March 10.

Note.—*All communications respecting Lectures should be addressed to Mr. John Stuart, Royal Concert Hall, St. Leonards.*

Contents of No. 105.

SPECIAL NOTICES.

Part XXIV. (October, 1883), now ready, price 10d., post-free, 1s. 1d.
Volume III., comprising the numbers published from January to June, 1883, now ready, price 7s. 6d.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOV. 16, 1883.

CONTENTS OF No. 107.

A NATURALIST'S YEAR.

By GRANT ALLEN.

UNDER FALSE COLOURS.

LAST night's frost has wrought great havoc among the few lingering belated summer insects, and combined with the wind and rain of yesterday has completely changed the whole aspect of native life in the country, both as regards the leaves on the deciduous trees and the lesser fauna of the thickets and hedgerows. The brimstone butterflies have retired quietly into the winter quarters, where they will hibernate in a drowsy torpidity till the desired return of spring; the daddy-long-legs flies are still feebly laying the eggs of their leather-jackets grubs among the dying roots of the cabbages or turnips; and a few stray humming-bird hawk-moths, stranded on the cold season, are trying even now to hunt up a head of red clover or a garden jasmine for a last carnival meal of scanty honey. But the insect world as a whole is dead, or at least dormant; and here on the path through the meadow I have seen already half-a-dozen dying bumble-bees—drones or workers, I suppose, for the fertile females retire for their long sleep into the soft moss or trunks of trees—who have fallen victims to the first really hard frost of the present season. Here is another, lying right in my way, cold and stiff—he has only escaped the hungry jaws of his hereditary foes, the harvest mice, to be cut off in the flower of his youth by the relentless fingers of fast-gripping Jack Frost. I will take him up and examine him closely, to see whether I can't find material enough in his poor, cold corpse for a short evolutionary article to be printed in next week's KNOWLEDGE.

Now this is really quite too bad and positively immoral on the part of my ungrateful, frost-bitten bumble-bee. I had got my article half-arranged and comfortably settled in my own mind already, as I carried him along gingerly between finger and thumb to the stile that leads into the Holmdale turnip-field; I was prepared to mourn over him as an idyllic creature that lived honestly, if not by the sweat of his brow, at least by the search after honey on his own account; and now that I have seated myself comfortably on the stile, and begun to examine him carefully with my little pocket lens, I find I was totally and utterly mistaken as to his very identity, and the miserable deceiver has been positively obtaining my sympathy under false pretences. He isn't a bumble-bee at all, as it turns out, but a true two-winged fly—*Volucella bombylans* is his Latin name—carefully tricked in a well-concerted disguise, so as to betray the very bumble-bees themselves into taking him for one of their own community. Well, well! I must console myself under the shock with thinking, not only that far better entomologists than myself have often been deceived at first sight by this treacherous Volucella, but also that the very bees in person can't properly distinguish it from their own legitimate hymenopterous sisters.

After all, the incident really in the end turns out to be a very happy one; for there are bumble-bees everywhere in plenty—like the poor, we have them always with us—but Volucella is an insect you don't come across every day, and it forms, perhaps, the very finest example of that curious biological phenomenon known as *mimicry* to be found anywhere in the British Islands. In actual fact, it is nothing more than a mere fly, belonging to the same great insect group—the Diptera—as the house-fly, the meat-fly, the gnats, the midges, and the mosquitoes, whose chief distinguishing mark it is that in them the hind wings have become reduced to a pair of very small knob-like structures, shaped exactly after the model of the clapper in a bell; but in outer form and colour it approaches so very near to the bumble-bees (which belong to the totally different group of Hymenoptera, including the bees, wasps, ants, and sawflies) that it is almost impossible to distinguish them from one another when on the wing. You have to catch a Volucella and examine it closely in your hands before you begin to perceive the immense number of important structural differences which underlie so close and deceptive an external resemblance. Volucella, in fact, is a fly which has taken to entering the nests of the bumble-bees, and laying its eggs there, side by side with those of the foundress bee who starts the colony. As the bee-larvæ emerge from their eggs, the Volucella larva also simultaneously hatches out, and begins at once to feed upon the helpless grubs of its unwilling hosts. This, of course, is a very disadvantageous practice—from the point of view of the bumble-bees at least; and they would never let Volucella penetrate into their subterranean nests if they could possibly detect and expel her. But, to prevent detection, Volucella has acquired an outer form exactly like that of the unhappy insects on whom her larvæ are parasitic. She is black and very hairy, about the size of a worker bumble-bee; and the colour of the hair is varied on different parts of the body, so as to produce a banded or variegated appearance, after the very fashion of her Hymenopterous victims. Nay, more, to complete the resemblance, she even buzzes exactly like the bees themselves. The consequence is, she can enter the nests of the bumble-bees quite unsuspected, and there lay her eggs in peace and quietness, producing larvæ which will feed hereafter to their hearts' content on the soft, nutritious grubs of the foundress bee.

Now, how did such a quaint resemblance between two totally unrelated and hostile creatures first arise? Mr. Alfred Russell Wallace, who shares with Mr. Darwin the honour of independently originating the fertile theory of Natural Selection, has clearly pointed out the general principle upon which we must explain all such cases of natural mimicry. The resemblance must have been developed by slow stages through the gradual eliminating action of natural selection itself; and in this particular

instance it is the suffering bumble-bees in person who have been the selecting agents to their own ultimate and permanent disadvantage. At first, we must suppose, some adventurous and original-mind flies of the family of Syrphidæ, the greater part of which in their larval condition live upon aphides or plant-lice and other small insects, must have taken tentatively to laying their eggs in the midst of the grubs of bumble-bees or similar hymenopterous species. But the bee would naturally object to this process, if he recognised the intruder as such, and would promptly proceed to sting him to death without further ceremony. Indeed, there is at the present day one parasitic enemy of bees, the little gold-wasp or ruby-tail, which similarly lays its eggs among the burrows of bumble-bees, and rears its larva on the fat young grubs of the rightful occupant; but this little miscreant generally pays its visits to the nest during the absence of the mother bee. If, however, the real owner returns while the gold-wasp is busy laying its eggs, she expels the intruder bodily, tumbling it out by main force, and would no doubt sting it to death, were it not that the gold-wasp is effectually protected by its hard and horny armour-plated suit. Probably the early ancestors of our Volucella did not possess any such external protection as the gold-wasp does, and so most of the flies which ventured into the bees' nests would be promptly detected, and immediately killed. But if there happened to be any which slightly resembled the bumble-bees themselves in form and colour, they might possibly be mistaken at a casual glance by the members of the colony for fellow-workers of the same nest, and so might lay their eggs in peace, leaving an ample progeny to batten on the larvæ of their unsuspecting hosts. The oftener the bees found this trick was played upon them, the warier and wilier would they grow as to the sort of strangers they admitted into the sacred precincts of the nest; and so, after a certain number of generations, they would gradually sting to death all the nascent Volucellas that did not quite come up to their preconceived notions of what a correct and thorough-going bumble-bee ought properly to look like. But in the very act of doing so, they would leave alive those only which approached so nearly to themselves in shape and hue as to be indistinguishable to their simple vision. From generation to generation this weeding-out process would continue unchecked, all the worst imitations being from time to time detected and destroyed, while only the very best and closest mimics were left to propagate the kind, and produce broods exactly like themselves. Thus, at last, quite unconsciously to the insect itself, the Volucella has grown into the precise counterfeit presentment of the bumble-bees, upon whose young its larva prays; and, strange to say, it has grown so by dint of the hostile efforts of the injured and outraged bumble-bees themselves. The fly they could discover and kill has passed away, leaving no descendants; but it is the progeny of the flies whose disguise they have never been able to penetrate that preys upon them with perfect impunity to-day.

Speed of Working on Submarine Cables.—According to recent trials of the speed of working on the Jay Gould cables laid across the Atlantic from Penzance to Canso, in Nova Scotia, 1,000 code words were sent from Penzance and received at the Canso station in 81 minutes, including all repetitions and corrections. The 1,000 words consisted of 7,288 letters, which is about equivalent to 1,458 words of five letters each, the average number for the English language.

STRANGE COINCIDENCES.

By Richard A. Proctor.

Many imagine that because of the singular nature of some series of coincidences, there must have been special significance in them. It is well therefore to notice that odd coincidences, in which it would be absurd to imagine any particular meaning, very frequently occur, nay probably are all the time occurring, only most of them remain unrecorded. A case was cited recently in the *Times*. A person whom we may call Brown No. 1, only the real name was not so common, found in his pass-book the sum £22. 0s. 7d. entered on the credit side, and not knowing how it came to be recorded there, asked for particulars. Inquiry being made, it appeared that the sum of £22. 0s. 7d. had been paid in for another customer of the same name (surname and Christian name both) on the same day that the entry of £22. 0s. 7d. had been made on account of Brown No. 1. It was naturally supposed that there was some mistake. But on further inquiry it appeared that both entries were correct,—the odd amount being made up in the case of Brown No. 2 by a number of small items, while in the case of Brown No. 1 the odd sum was a dividend on some Indian stock. If the case were not so obviously insignificant, how clearly it would seem that there was a special meaning in the series of coincidences. That among the customers of a bank two should have the same (not very common) surname and Christian name, is not very wonderful. That to two customers the same sum should be paid in on the same day would not seem very wonderful, unless, as in this case, the amount were rather an odd one,—and even then, if the amount arose in the same way, as a dividend for instance on a round sum like £1,000, it would not be very remarkable. But the actual combination was exceedingly remarkable, and if one could only imagine any conceivable warning or token conveyed by facts so unimpressive in themselves, one would say here certainly was a sign or portent meant to be most carefully attended to.

I was reminded of this *Times* story by two or three odd little coincidences which happened to me lately—all within a week.

First, I received when at Plymouth a letter from the neighbourhood of Birmingham, in which an old college acquaintance, a "stroke" behind whom I had rowed in several races, invited me to stay at his house during my visit to the Midland metropolis. Within a few hours, I receive a letter from another old college friend, a stroke behind whom I had rowed in several races, inviting me to stay at his house in Tavistock during my lecture tour in the west. I had not seen or heard from (or even heard of) either of these Johnians for more than 25 years. Moreover they were the only strokes behind whom I ever rowed in college races, having myself been stroke in all the other races in which I rowed. It was surely an odd thing that when in a city far from the abode of either, I should within a few hours receive letters from both to the same general purport. Yet as surely I could find no sign or portent in the matter.

Four days later I learned at Malvern that a letter duly placed in the delivery box of the Queen's Hotel, Birmingham, had been delayed in transmission. I presumed it had been put in when the box was empty. The envelope was a large light-brown one (almost half as large as a page of Knowledge), the contents not enough to take away from the flatness of the letter, and I fancied it must have lain unnoticed when the small letters above it were taken out. Hearing of its non-arrival in London, I telegraphed

to the manager of the hotel (where I expected to be the same day), "Important letter posted Tuesday not yet received" (Thursday); "see if in your letter-box," &c. This was misunderstood, and reply came, "Large packet of letters received; am forwarding it and other letters by 12.40 train." My reply to hold letters till I came was just in time to prevent a number of KNOWLEDGE letters from being sent on a useless journey, which would have considerably delayed my work with them. The way in which the letter had miscarried was rather strange. I had written a little note on the corner telling the person to whom the letter was sent what my address would be the following day; and some foolish clerk had carefully sent the letter, *not* to the address written staringly across the envelope, but to the address appearing as part of this little corner note. (It is hardly necessary to say that after this foolish blunder and the annoyance caused by it all round, an extra charge was made when the letter was delivered.) Here the coincidence consisted in the odd and almost inconceivable stupidity of the post-office people on the one hand and on the other in the circumstances which made it antecedently likely that the mistake arose at the hotel. Then the misinterpretation of my telegram came to complete the cross-purposes. In this case there was really a warning. For it made me tremble (with two r's) to think what would have happened if my editorial letter to the printers with make-up, proofs, &c., &c., were at any time to be similarly interrupted in transit.

However this was not quite the end. After sending off the second telegram, I was on my way from Malvern to Birmingham where I expected to be at 4.47. Changing at Worcester I had bestowed myself in a first-class through carriage for Birmingham. Now, grant the following conditions, and consider the infinitesimal minuteness of the chance of my *not* reaching Birmingham by that train:—First, I am *alone* in a first-class carriage; secondly, the carriage is really a through one for Birmingham; thirdly, no accident occurs; fourthly, no occasion arises for me to leave my seat; *but*—here are the elements out of which disturbance is to be produced—fifthly, *two* first-class passengers are at Bromsgrove (where we get 21 minutes after leaving Worcester) intending to go to Derby; one second-class passenger is alone in a rear carriage of the train I am in; that rear carriage is badly attached; at Barnet Green there is an excitable station-master; and finally in our train there is a stolid guard. Can *these* elements be so combined as to cause me to be delayed at Birmingham, and so to lose certain opportunities for work, on which I had counted? They *could*, unlikely though it may seem: and as a matter of fact they *did*. The two first-class passengers get by mistake into a Birmingham carriage; the second-class passenger, being alarmed by the swaying of his carriage, gets into mine; a telegram is sent to Barnet Green "two first-class passengers for Derby in the Birmingham train:" excitable station-master there says to stolid guard, "Find two first-class passengers for *Birmingham* (*sic*) and put into forward carriage;" stolid guard though knowing (it appears later) that the forward carriage is *not* going to Birmingham, nevertheless does what he is told. I and unfortunate fellow-passenger (who is going up to Birmingham to get ten minutes' talk with a friend who leaves at 5.10) are busily bundled into the wrong carriage; and at the next station are informed by stolid guard that it does not go to Birmingham. I am left to kick my heels till a train arrives which will take me to Birmingham; and unfortunate passenger takes the next train back to Worcester. What were the chances that these things, unless specially *planned*, would have come off so strangely?

If it had so chanced that either the carriage I got out of or the one I got into had been smashed up in a railway accident, what view ought I to have taken of the escape in the one case or the mishap in the other? When I was injured in a railway accident last July it happened by a singular chance that my wife, who with some relatives had been travelling with me up to the previous evening, was for a few hours not in my company, but was to have joined me at Bishopstoke; into which place my train was running when the collision took place. If I regard it as a lucky chance, which assuredly I do, that she was not just then with me, how am I to view the unlucky chance for me that just then I was not with her? A thought of that sort always suggests itself to me when I hear expressions of special thankfulness for escape where others have suffered. Logically one cannot assert special favour in one set of cases without asserting special disfavour in the others. I suppose, indeed, it is thus that persons who (being of unscientific turn of mind) have no idea of causation, recognise special judgments when some striking accident happens, deeming that those destroyed must needs have sinned in some way beyond other men,—an idea still commonly entertained though so strongly rebuked when propounded in the case of the Tower of Siloam. Even more unreasonable is the idea that though most of the men, women, and children, who perish in some great disaster—like the destruction of the *Princess Alice* for example—were no worse than their fellows, the disaster was specially sent to punish some national shortcoming, for which they were the scapegoats. Here is the veritable Oriental idea of Deity, as originally conceived by those who knew and reverenced only one form of power, that of the Sultan or Caliph, who, when offended, deems it good policy to punish the offender's kindred, however innocent of offence.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XX.—CONCLUSION.

THE serial form of publication has its advantages in these run-and-read days in compelling the writer to pack his thoughts closely together, but it has its disadvantages in breaking their sequence, and compelling the reader to turn to back numbers for the missing links.

The multitude of subjects traversed in these chapters compelled presentment in so concise a form that any attempt to gather into a few sentences the sum of things said would be as a digest of a digest, and it is, therefore, better to briefly emphasise the conclusions to which the gathered evidence points. It was remarked at the outset, when laying stress on the serious meaning which lies at the heart of myths, that they have their origin in the endeavour of barbaric man to explain his surroundings. The mass of fact brought together illustrates and confirms this view, and has thereby tended to raise what was once looked upon as fantastic, curious, and lawless, to the level of a subject demanding sober treatment and examination on strictly scientific methods.

Archbishop Trench, in his "Study of Words," quotes Emerson's happy characterisation of language as fossil poetry and fossil history: "Just as in some fossil, curious and beautiful shapes of vegetable or animal life, the graceful fern, or the finely-vertebrated lizard, such as have been extinct for thousands of years, are permanently bound up with the stone, so in words are beautiful thoughts and images, the imagination and the feeling of past ages, of men long since in their graves, of men whose very names

have perished, preserved and made safe for ever."* In like manner, we may speak of myths as fossil ethics and fossil theology, but, with more appositeness, as embryonic ethics and theology, since they contain potentially all the philosophies and theologies "that man did ever find."

And to the student of the history of humanity who rejoices in the sure foundation on which, tested in manifold ways, the convictions of the highest and noblest of the race rest, the value of myth is increased in its being a natural outgrowth of the mind when, having advanced to the point at which curiosity concerning the causes of surrounding things arises, it frames its crude explanations. For not that which man claims to have received as a message from the gods, as a revelation from heaven, but that which he has learned by experience often painful and bitter, and which succeeding generations have either verified or improved upon, or disproved altogether, is, in the long run, of any worth. Through it alone, as we follow the changes wrought in the process from guess to certainty, can we determine what was the intellectual stage of man in his mental infancy, and how far it finds correspondences in the intellectual stage of existing barbaric races.

Thus, the study of myth is nothing less than the study of the mental and spiritual history of mankind. It is a branch of that larger, vaster science of evolution which so occupies our thoughts to-day, and with which the philosopher and the theologian must reckon. The evidence which it brings from the living and dead mythologies of every race is in accord with that furnished by their more tangible relics, that the history of mankind is a history of slow but sure advance from a lower to a higher; of ascent, although with backslidings oft. It confirms a momentous canon of modern science, that the laws of evolution in the spiritual world are as determinable as they are in the physical. To this we, for the enrichment of our life and helpful service of our kind, do well to give heed. Wherever we now turn eye or ear the unity of things is manifest, and their unbroken harmony heard. With the theory of evolution in our hands as the master-key, the immense array of facts that seemed to lie unrelated and discrete, are seen to be interrelated and in necessary dependence—"a mighty sum of things for ever speaking." That undisturbed relation of cause and effect which science has revealed and confirmed, extends backwards as well as reaches forwards; its continuity involves the inclusion of man as a part of nature, and the study of his development as one in which both the biologist and the mythologist engage towards a common end.

A New Selenium Cell.—At the recent meeting of the American Association for the Advancement of Science, Professor Mendenhall announced the formation of selenium cells of very low resistance by Mr. C. E. Fritts, of New York. Low resistance selenium cells are a desideratum, and Mr. Fritts' cells, the full construction of which was not explained by Professor Mendenhall, attain their end by means of large surfaces of selenium, instead of narrow surfaces as in the older cells. Another peculiarity, which involves a new observation, is that the light in the Fritts cell is allowed to fall on the selenium in the same direction as the electric current passes, and not at right angles to the direction of the current. This is a very important point, demanding further investivation, and now that selenium can be manufactured more cheaply it will probably be largely experimented with. The cells of Mr. Fritts can be made of 9 to 10 Ohms resistance. They can, moreover, be easily repaired on breaking down.—*Engineering.*

* "Study of Words," p. 5.

TRICYCLES IN 1883.

By John Browning,

Chairman of the London Tricycle Club.

MUDGUARDS, WRINKLES, LUBRICANTS, AND BRAKES.

A RECENT number of Knowledge contains a request from a correspondent for advice respecting the use of mudguards. During the same week I received letters from other correspondents asking my opinion respecting lubricants, brakes, and the construction of the Humber tricyle. As these matters are all of general interest I propose to answer them in this article.

With reference to mud-guards, I may say at once that the experience of my friends, as well as my own, is that we do not get so muddy when riding small-wheeled tricycles as when riding machines with larger wheels, because the tyres are so low that they do not touch us. Hind-wheel-steering tricycles, though inferior, on the whole, to front steerers, are decidedly superior to them in respect of cleanliness in riding. But if a front steerer has a mudguard of stout leather, in the shape of a triangle, the base of which is downward and comes within two inches of the ground, attached to the thin iron guard which is always fixed to it by the manufacturers, there is little difference to choose between them.

Light leather guards could easily be fixed above the side wheels to any small-wheeled tricycle, so as to catch all mud thrown off by them in such a direction as to reach the rider.

Respecting lubricants, the best known for general use is made by adding two or three teaspoonsful of paraffin to a pint of sperm oil. This mixture also burns well in tricycle lamps. Mr. Grace has used with success as a lubricant vaseline thinned with sufficient paraffin to enable it to be poured into a pocket oil-can.

For the chains of my tricycles, I have for some time used vaseline and finely powdered plumbago or black-lead. This has the disadvantage that dust adheres to it.

Mr. Grace has shown me that paraffin and black-lead applied to chains quickly dries, and leaves a surface to which dust will not adhere. After two or three applications the chain becomes coated with black-lead, and runs silently.

I do not propose to say anything about tyre-brakes, as they are almost extinct, and will soon, I trust, be quite so. With hand-brakes the great difficulty is to prevent any oil from getting on to the drum. When this happens, it generally arises from the chain having been too profusely oiled. By adopting the paraffin and black-lead as a dressing for the chain the risk of this mishap, which may lead to a very serious accident, will be avoided. Should it have happened that oil has got upon the drum, first wipe it as dry as possible, and then crush some common resin upon the drum, and work it into the leather band by holding the brake very lightly on, and moving the machine about. Repeat this several times if necessary.

Powdered resin, mixed with *a very little* oil, is an excellent dressing for the strap of a hand brake, but I have found vaselin with a small amount of whiting still better.

Here I must add a word of caution not to apply either of these compounds to the band-brake of a Humber tricycle, as the action of the brake of this machine, without anything to increase the friction, is sufficiently powerful, and one of the great difficulties experienced in riding it consists in the ease with which the hind wheel is lifted off the ground by putting on the brake. I have accustomed myself to ride my small Humber with only the

first finger of my right hand on the handle of the brake. Even using one finger to check the machine in this manner, I have frequently lifted the hind wheel when I have been compelled to apply the brake rather suddenly, and that when I have been riding up hill.

A correspondent to whom I am indebted for a thoughtful communication, asks me if the "Humber" "would not be improved on the score of safety by throwing more weight on the hind wheel, so as to keep it more firmly on the ground?"

My reply, given after a year's continuous practice in riding the machine, is that, paradoxical as it may appear, the more weight you place upon the hind wheel the more difficult it becomes to control the machine.

The secret of riding the "Humber" is to lean well forward so as to take as much weight off the hind wheel as possible without going over the handles. When going down hill, if the hind wheel gets into a rut or deep dust or stiff mud and the machine will not answer in steering, the only way to get over the difficulty is to lean forward as far as you safely can, to apply the brake *cautiously*, and to drive forward against the brake. This will steady the machine directly, and cause it to answer the steering perfectly.

THE SUN'S DISTANCE.

By Professor R. S. Ball, LL.D.,

Astronomer-Royal for Ireland.

(*Continued from page 285.*)

It was on the first night of the present century, a date very easy to remember, that the first of the minor planets was discovered; a few others were quickly added, and forty years later the career of discovery was re-opened. Fresh planets were added by units, by tens, and by scores, until at the present moment we recognise about 240 of these objects revolving around the sun in the gap between Mars and Jupiter.

The sun, which controls the mighty planets of our system, does not disdain to guide with equal care the tiny globes which form the minor planets. Each revolves in an elliptic orbit, and at certain times some of them approach near enough to the earth to have their distances measured. The observations can be made with very great precision; they can be multiplied to any extent that may be desired. They can be discussed with geometrical accuracy, so that from them one result and only one can be deduced.

In speaking of these planets as small objects, I must be understood to use the words in a comparative sense. They are small as planets, but perhaps the area of an average one might be comparable with that of a good-sized English county. The discoveries of minor planets have added enormously to the labours of those astronomers who compute the movements of the solar system. The task of predicting the places of the minor planets has been for many years most ably accomplished in the Berlin "Ephemeris." The editor must be sometimes alarmed at the daily extension of his list.

Many of these bodies are of but little interest. Perhaps it would be no great harm to allow a good many of them to get lost again and be no more followed by telescopes or computers. Some of these little bodies have, however, a great astronomical future. They seem destined to tell us more faithfully than Venus or than Mars what is really the distance from the earth to the sun. The very small ones will not answer; they can only be seen in very powerful telescopes, and they do not admit of being measured with the necessary accuracy. It is also obvious that the planets to be chosen must be as near to the earth as possible. They should have orbits possessing a high degree of eccentricity, so that when in perihelion and in opposition simultaneously the approach may be made as close as possible. Under favourable circumstances a minor planet will approach the earth to a distance but little more than three-quarters of the distance of the sun. These various conditions limit the number of minor planets available for this purpose to about a dozen, of which one or two will usually be suitable each year.

About two years ago Mr. Gill invited astronomers in the Northern Hemisphere to co-operate with him in the Southern in an attempt to apply this method to Victoria and to Sappho. It became my duty to co-operate in this scheme so far as my opportunities went. As the planet pursues its course through the sky, and as the sky is everywhere studded over with countless myriads of minute stars, it is evident that the planet itself so like a star will always have some stars in its immediate neighbourhood. As the movements of the planet are well known, it is possible to foretell where it will be on each night that it is to be observed.

The scheme was completely drawn up many months before the observations were to commence. Each observer who participated in the work was thus advised beforehand of the stars which were to be employed each night. Viewed from any part of the earth, from the Cape of Good Hope or from Great Britain, the positions of the stars are absolutely unchanged. Their distance is so stupendous that a change of place on the earth displaces them to no appreciable extent. But the case is different with Victoria. It is hardly one millionth part of the distance of the stars, and thus the displacement of the planet when viewed from the Cape and when viewed from Europe is measurable. The measurements are made from a comparison star with a micrometer or a heliometer. The star is one beautifully-defined point, the planet is another, and the difference of declination between the two can be measured with a high degree of accuracy. Two comparison stars symmetrically placed with regard to the planet are usually employed, as a number of sources of error can be thus eliminated. The displacement of the planet is to be elicited by comparison between the observations in the northern hemisphere with those in the southern hemisphere. The observations must be made as nearly as possible at the same time, due allowance being made for the motion of the planet in the interval.

Although every precaution is taken, yet the fact remains that we are obliged to compare the measures made by observers in the northern hemisphere with those made by different observers, and, of course, with different instruments in the southern hemisphere. In this respect we are, no doubt, at no greater disadvantage than in the transit of Venus; yet it is possible to obviate even this difficulty, and thus to give the minor planet method a great advantage over its rival. The difficulty would be overcome if we could conceive that an observer and his observatory, after making a set of observations on a fine night in one hemisphere, were to be transferred, instrument and all, to the other hemisphere, and there to repeat the observations. This problem can be solved without any miraculous agency, and in it we have undoubtedly the most perfect mode of measuring the sun's distance with which we are acquainted.

This method has already been carried out with success by Mr. Gill in the case of Juno, but there are other planets more favourably situated, and the work can be done for a

mere fraction of the expense of the much more cumbrous transit of Venus. Take, for instance, one of the little planets which sometimes approach to within 70,000,000 miles from the earth. When the opposition is drawing near, a skilled observer is to be placed on some suitable station near the Equator. The instrument he is to use should be the heliometer. It can be used to measure stars at a greater range than is attainable with the filar micrometer. The measurements are to be made in the evening as soon as the planet has risen high enough to enable it to be seen distinctly. The observer and the observatory are then to be transferred to the other side of the earth. How is this to be done? Say, rather, how you could prevent it being done. Is not the earth rotating around its axis, so that in the course of a few hours the observatory on the Equator is carried bodily round for thousands of miles? Before the morning dawns the observations are to be repeated. The planet is found to have changed its place very considerably with regard to the stars. This is partly due to its own motion, but it is also largely due to the parallactic displacement arising from the rotation of the earth, which may amount to as much as twenty seconds.

The measures on a single night with the heliometer should not have a mean error greater than one-fifth of a second, and we might reasonably expect that observations could be secured on about twenty-five nights during the opposition. Four such groups would give the sun's distance to one-thousandth part. The chief difficulty of the process arises from the motion of the planet during the interval which divides the evening from the morning observations. This, it must be admitted, is a drawback to the method. It can, however, be avoided by diligent and repeated measurements of the place of the planet with respect to the stars among which it passes.

Let us hope that long before another transit of Venus shall come round the problem will have been satisfactorily solved by the minor planets. It will surely be expected that I shall not close this lecture without an attempt to say what the distance of the sun is so far as modern research has gone. Reviewing all the different methods, the most probable value seems to be 92,700,000 miles. It does not seem likely that this can be erroneous to the extent of 300,000 miles. The distance of the sun is one of the most important constants in the universe. It is indeed a constant in a very emphatic sense. The planetary perturbations which affect so many other elements of the solar system are powerless to touch this constant. Once the distance of the sun has been measured, the telescope with which the observations were made may moulder, and the astronomer who used it may survive only in name, but the work he has accomplished will remain true for countless ages of the future.

ON LUNAR DELINEATION.

By the Rev. T. W. Webb.

Attentive observation of the lunar surface has now been, from various causes, comparatively dormant on my part for a considerable time, though not, I hope, without the prospect of renewal at some future day. But, in the meanwhile, it has given me great pleasure to remark with how much earnestness and success these inquiries have been pushed forward by younger hands, and how far selenography stands in advance of the position it occupied during the earlier portion of the present century. There is little occasion for surprise in this. During a period when a new and unprecedented interest has been awakened in astronomical pursuits, and competent instruments—to say the least of them—have been placed within the reach of all classes, nothing could be more natural than that attention should be directed to an object so comparatively near, so frequently visible in its returns, so accessible even to small telescopes, and so crowded with strange configurations as our own satellite; and many an amateur, who would be baffled from deficient optical power, or want of experience, in an attack upon planetary details or "close doubles," may be readily attracted by the broadly developed surface of the moon, and become anxious to know how he may turn to some useful account his opportunities of observation. And as far as the readers of Knowledge are concerned, the recent interesting and valuable series of papers by "F.R.A.S." would contribute largely to encourage such a taste, and to lead young or unpractised observers not merely to run over that strange and fascinating scenery with a superficial gaze, but to study its features more carefully in detail, and if they have some facility with the pencil, to attempt its delineation. This would certainly be a most interesting employment of spare time, and with diligent perseverance might lead to a degree of success which would fully justify the pains expended upon it at the outset. It is with a view of assisting such beginners that I propose to bring the following remarks before them.

We may begin by setting aside any discouragement from the success that has attended photography—as to which it may be supposed that from the marvellous development of its resources it must soon supersede every other mode of delineation. There is, indeed, much in such an objection, but not enough to discourage the efforts of a careful artist. The great strength of photography lies in the fact that it misses nothing. It would hardly be supposed by those unacquainted with the subject how fallible is the vision of an ordinary, sometimes even of a trained eye, or how often features are overlooked, especially in a hasty observation, which are recorded by the camera. Nor can we question its great advantage in point of rapidity, and, when suitably arranged, facility of manipulation. But there is something to be said on the other side. Photographic appliances are within the reach of comparatively few of those who are qualified to do good service, and the opportunities for really sharp camera-work are limited, as compared with those for direct eye-observation, for the evident reason that in the one case a satisfactory result can only be obtained from such uninterrupted steadiness of definition as may be long waited for in vain, in the other the eye may be often capable of laying hold on the true form and character of an object, notwithstanding the interference of such atmospheric agitation as would render the camera useless, or of utilising the happy intervals in an unquiet hour, when a momentary clearing brings out in beautiful distinctness features immediately lost again in impenetrable diffusion. For the general mapping of an extensive region, and laying down its form and boundaries in due proportion, photography is by far the best suited; but there may always be room for filling-in detail by the eye. It is best to understand at once that if we hope to make our work really useful, we must lay aside all ideas of representing large areas—for one reason, because all that work has been abundantly done already; and for another, because, during the time that would be necessarily occupied in such a sketch, the illumination of objects lying respectively far to the E. or W. would have altered sufficiently to make the design inaccurate at one end or the other, however faithful in separate details. And, for more than one reason,

nothing should be attempted that cannot be well mastered in a single observation.

Then, again, something has to be said as to the necessity of a certain degree of proficiency in the art of correct drawing. An eye sufficiently accurate to comprehend the proportions of what lies before it is by no means of constant occurrence; nor a hand adequately trained to transfer them faithfully to paper. Artistic taste is not much concerned in the matter. We do not want a pleasing picture, but a faithful likeness; and the two are not always as well balanced as they are in the portraits, alike beautiful and accurate, given by Green in his views of the planet Mars. Practice, however, will do much to improve both eye and hand; and especially a resolute determination not to be discouraged by early failure.

Again, it is an indispensable qualification to be well acquainted with "relief," as shown by light and shade, without which we may be needlessly surprised, or even hopelessly perplexed, in the interpretation of what we see. In this important respect we may especially recommend the careful examination of a somewhat irregular white surface, such as a sheet of plaster of Paris, or even smooth mortar, spread on a board, on which elevations or cavities may be formed; the oblique exposure of this to the light of the sun, or a lamp, from either side, and at varying angles, will readily show what strange differences of aspect may result from so simple a cause. With certain forms, and in certain positions, it will soon be seen how great a proportion those differences bear to a comparatively slight change in the direction of the incident ray; what "giant-like" dimensions may be assumed by the shadows of moderate elevations, what pointed spires of blackness may be formed, perhaps for a short time only, by blunt or rounded summits, and what singular deformations may take place when they are thrown across or terminate in irregular ground. The effect also must be noted of a slight variation in the direction of the illumination, not only, as is constantly in progress, from W. to E., or the reverse, but on certain occasions also from N. to S. Such a variation actually exists in consequence of a slight inclination of the Moon's axis to the plane of its orbit, and though very limited in amount, it may, under some conditions, be appreciable enough to produce changes that would otherwise be unintelligible; a straight ridge, for instance, running E. and W. with a similar inclination on either hand, might from this cause cast a shadow now on one, then on the other side, or become imperceptible from want of shade, according to the variation in the lunar azimuth of the rising or setting sun. Or a group of luminous points, the summits of some lofty and complex mountain mass, just touched beyond the terminator by the rays of the rising or setting sun, may appear to vary in form or number in different lunations, from the same cause, which is equivalent to a very slight change of seasons on the Moon.

Again, we must not leave out of account the change of perspective foreshortening due to the effect of libration, which is constantly varying, from night to night, the position of objects as referred to the limb, or, what is of course the same thing, the apparent centre of the lunar disc. It is not necessary in this place to enter into the cause or the limits of this disturbance in the optical presentation of the moon's visible hemisphere to the earth; but the attentive observer will soon be sensible of its existence, from the changing proportions of the ellipses into which the circular formations are projected, and the varying visibility of minute details, especially on slopes receding from the eye. The perspective alterations arising from this cause increase, of course, rapidly with the increasing distance from the centre of the disc; and towards the limb they become so exaggerated, and often puzzling, that it would be mere waste of time for a beginner to attempt the delineation of those regions; excepting, indeed, in one case—that of actual representation in profile. For it occasionally happens near the time of full moon that some huge mountain mass, such as Leibnitz or Dorfel, is thrown up in imposing relief against the dark sky beyond the regular circle of the disc; or that the points of the crescent are carried on in detached patches—islands, as it were, of light—along the dark limb. Such projections lend themselves readily to the pencil, and offer an outline worthy of preservation.

The facility of delineation is increased by the uniformity of tone in the shadows, which, in the absence of a reflective atmosphere, are of unbroken blackness. Their edges, too, are sharply defined; for though they must be attended, like every terrestrial shadow, by a penumbra, or dusky border, arising from the breadth of the star-disc, yet this, excepting in very oblique illumination close to the terminator, subtends too small an angle at the distance of the moon to be worthy of notice; in fact, it would not be perceptible with such instruments or magnifying powers as are now under consideration.

It is scarcely necessary to say that in such work a loose, undecided, *sketchy* manner is especially to be avoided. Such designs may possibly recall what was actually seen to the mind of the artist himself, but to others they may only be unintelligible or even misleading. The rule of good drawing in ordinary cases is at least equally applicable here—that every line should have a meaning. As far as possible, nothing should be left to memory; and an approximate date should accompany every drawing, together with a specification of the size and power of the telescope employed, and the quality of definition.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

By Richard A. Proctor.

(*Concluded from page 276.*)

EVERY one who has been much at sea must have (or rather *ought* to have) noticed how very markedly even a slight change of elevation affects the apparent position of the sea horizon as seen athwart the upper masts of a distant ship. Where the sea horizon crosses the lower masts the effect is not so marked; but when the air is clear so that the sea horizon is sharply defined and the ship beyond it clearly seen, the change is obvious enough in this case also. I have often been struck by the singular way in which a distant ship seems to rise and sink bodily as you watch it through a good glass, when in reality the change is due to the steady and almost imperceptible pitching of the ship from which you view her. To catch this effect best you should observe of course from the bow or stern, when the ship is crossing a long swell, the swell being very slight and the sea in other respects as still as may be. You rise and sink then through perhaps three or four feet by a slow movement scarce noticeable under any circumstances, and quite imperceptible when the eyes are directed on a distant hull down ship. It is obvious that as you thus rise and sink the line to the horizon sways over the curved surface of the sea, somewhat as a plank might seesaw over the large round trunk of a prostrate tree. We see from Fig. 20 why the effect would be greatest on a distant object. For if a, b, are the positions of the eye as

the stern or bow of a ship rises and sinks, the lines *a* A *p*, *b* B *q*, separate more widely the farther they are carried from A and B. Thus on a ship at P the distance *q p* separating these lines might be half the height of the mast, while on a similar ship at P′ the corresponding distance *q′ p′* might be but a quarter of the mast's height.

All this is so obvious that it scarcely needs dwelling upon; though it is strange how few of those who have the phenomenon before their eyes even notice its nature, far less consider its significance. When observed and considered a little, it constitutes one of the most effective illustrations of the earth's rotundity I know of.

But I have in reality introduced this ocean proof for the purpose of introducing another, which struck me as one of the most singular in appearance of all the effects of the earth's rotundity I had ever noticed. It will be observed that the line *a* A, Fig. 20, is considerably longer than the line *b* B, so that an object of given dimensions just on the horizon for the point *b* would look considerably larger than a similar object just on the horizon for the point *a*. At sea one has no chance of noticing the effect of this change of horizon distance, for the simple reason that there is nothing to guide the eye as to the real distance of the sea-line. But on land it may in certain cases be different.

Fig. 20.

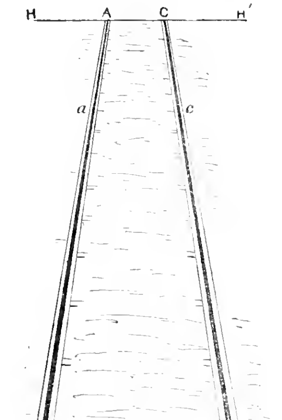


Fig. 21.

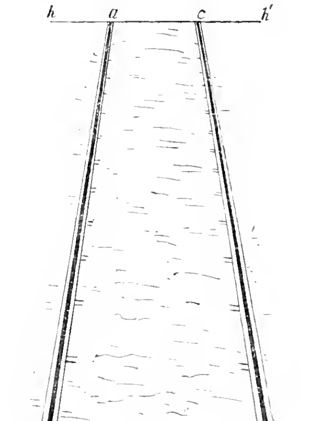


Fig. 22.

Thus the prairies in America are in some places perfectly level over a length and breadth of many miles. Suppose now that two parallel lines were drawn from C, Fig. 20, on the surface of the earth (whether sea surface or absolutely level land surface) towards B and A. Then from *a* the apparent extremities of the two lines (at the horizon) would be seen at A, while from *b* the apparent extremities of the two lines would be seen at B; and since *a* A is greater than *b* B, it follows, since the lines are parallel, that the apparent extremities as seen from *a* will be nearer than as seen from *b*.

Now, in travelling by rail over the prairie regions in America, one occasionally passes over a perfectly direct track on an unchanging level for several miles. And then one can look back from the rear carriage on two parallel lines just such as I have considered in the last paragraph. Suppose now that standing up on the rear platform the eye is as at *a*, Fig. 20. Then the rails will be seen as at B A, D C, Fig. 21, meeting the distant horizon H H′ at A and C. But if now, by stooping, the eye is brought to a considerably lower position as at *b*, Fig. 20, then the rails will be seen as *b a*, *c d*, Fig. 22, meeting the less distant horizon *h h′* at *a* and *c*,—*a c* appearing considerably greater than A C, for the simple reason that it is really the same distance (viz. the breadth between the rails) seen much nearer. (In Fig. 21, *a c* indicates the change of distance as compared with A C).

I have never so thoroughly *felt* the rotundity of the earth as I did on the day (in the spring 1880) when first this illustration occurred to me. I was on the rear platform of a train running smoothly and swiftly over the prairie region of Kansas. In the clear air of that region the two rails on

which we were running seemed to meet the horizon in two sharply defined points like the ends of two slightly slanted rods. Lowering the body the ends drew apart. Raising it they approached again; and alternately raising and lowering the body, keeping the eyes steadily fixed on the horizon, the ends seemed to approach and draw apart as if really moved to and fro.

Of course, this was not in itself a proof of the earth's rotundity, only an illustration. For, a believer in a flat earth might argue that the surface of the prairie was really rounded, and could no more prove the earth rotund than a round hill could. But the illustration becomes a proof for those who know the enormous range of the prairies in Western America, and that if the earth were flat, and the phenomenon we are considering had to be explained by a rotund prairie, the rotundity would have to rise many miles above the earth's level to explain a phenomenon observable over so great a range in distance.

But these papers are not in any case intended for the believers in a flat earth. These are really so few and so foolish that they are not worth the trouble of convincing, even if it were possible to convince by reasoning those who want reasoning faculties. It would be as reasonable to invite a cherub to take a chair as to offer arguments to the earth-flatteners. Our Pretty Proofs, though most of them are really proofs, have been offered chiefly as illustrations likely to interest those who know that in hundreds of ways the rotundity of the earth, the distance of the sun, and the dimensions (generally) of the solar system, have been placed beyond all possibility of doubt and question.

The End.

SEA ANEMONES

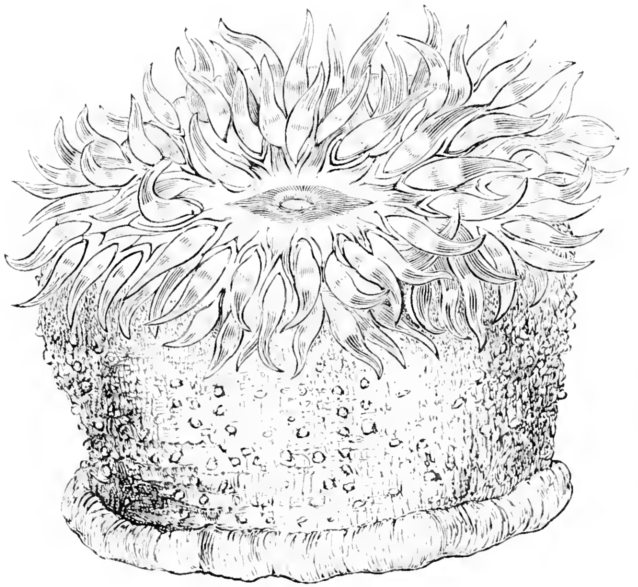
AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

VIII.—THE DAHLIA.

Actinia crassicornis (Müller). *Actinia coriacea* (Cuvier).

THIS large, handsome anemone is found abundantly along all the British coasts. Only one other species, the Strawberry, is more numerous. In colour the Dahlia is very capricious; its disk and tentacles sometimes display rich purple and amber hues, at other times the most delicate rose and white tints. In some instances the disc is rich orange and crimson, and the tentacula are of the purest white, while other varieties are met with comparatively dull in colouring. The tentacles usually are thick short, obtuse, and annulated with white and red. When however, the column is of uniform flesh or cream-colour they are of the same hue and without rings.



Dahlia Anemone the natural size.

In the Fisheries Exhibition there were many fine examples quite equal in size to our illustration. At the present time are to be seen in the Brighton Aquarium, many individuals and some groups not inferior in any respect to the handsomest exhibited at the Fisheries. The curator, Mr. Lawler, has been most successful in this department, and with excessive care has succeeded in maintaining for some years one of the finest exhibitions of sea anemones in the United Kingdom.

A distinctive feature of Crassicornis is the quickness with which its body is swollen with water and assumes a bladder-like and diaphanous form. In this condition the

tentacula are elongated and can be distinctly seen to be tubular with an orifice at each apex, and when touched after being taken out of their native element, will sometimes squirt thin jets of water more than a foot in height, and these will continue to rise until the body is nearly emptied and diminished to half its former dimensions.

This species varies widely also in wartiness; in some individuals these protuberances are very small, and in others the body is quite smooth. More frequently, however, the column is covered with warty glands, by means of which gravel and fragments of shells are attached to it so as to completely obscure the animal, and produce the appearance of a heap of sand and shells. Mr. Gosse, with respect to this habit, observes that you may hunt among the rocks till the rising tide covers them and, finding hundreds of Strawberries but not a single Dahlia, go away with the conviction that the latter is a scarce species; but to-morrow an initiated friend accompanies you to the same spot, and, pointing with his toe to the angle, says, Here they are! and here! and here! Three, four, and half a dozen in a group, and you are tired of collecting before the profusion fails.

Dr. Johnston, the chief authority between Ellis and Gosse, asserts (Vol. I., p. 226) that Actinia crassicornis never indues itself with an extraneous covering, which statement is true only of specimens found in deep water and tidal hollows that are always full. In such situations this gorgeous being remains constantly expanded and unconcealed. The doctor's declaration means, apparently, that he had never met with a specimen on the dry beach.

Although Dahlia is among the largest and most showy of British anemones, and very attractive in an aquarium, it is very troublesome and difficult to keep in health. If not carefully removed from its site with the stone to which it is attached, it will rarely live even for a week, and the least injury to the base or column nearly always proves fatal.

After obtaining a perfect individual free from injury, the utmost possible care should be used in cleansing the stone and keeping the water in the tank pure. On the other hand, as a recompense to the collector for his trouble, it must be remembered that this species is very beautiful, and if a few examples can be obtained and kept in health, they will add greatly to the beauty of his tank.

The tentacles possess the power of clinging strongly to any substance with which they come in contact. On one occasion, says Mr. Crouch (Johnston, I., p. 225), while watching a specimen that was covered merely by a rim of water, a bee, wandering near, darted through the water to the mouth of the animal, evidently mistaking the creature for a flower, and though it struggled a great deal to get free, was retained till it was drowned, and was then swallowed.

A few old writers have related as a fact that Actiniæ were occasionally eaten as a delicacy, and some modern philosophers by a process of inductive reasoning have arrived at the conclusion that sea anemones generally, and Crassicornis more particularly, should be good for human food, and have made most laudable efforts to prove the truth of their reasoning in a practical way. They have proceeded so far as to cook and to eat (or rather swallow) specimens of this species, with the curious result that though they commend the dish to others, they express no wish themselves again to partake of it.

Abbé Dicquemare, Professor of Experimental Philosophy at Havre de Grâce, in a paper which was read before the Royal Society, gives his surmises and subsequent experiences as follows:—"Might not these animals become a fresh supply for our tables, and thereby make amends for the consumption of muscles on which they feed? In order to try the experiment, I gave some anemones boiled in plain water to a cat, who devoured readily twenty of them without any bad effect, and seemed wishful to have more. This induced me to make a further trial, and to get some of them colloped as we do oysters. I swallowed them up myself. Perhaps they may prove still more palatable dressed in some other manner; however, they may be eaten safely."

In another paper, Professor Dicquemare says, "Of all the kinds of sea anemones, I would prefer this for the table. Being boiled some time in sea water, they acquire a firm and palatable consistence, and may then be eaten with any kind of sauce. They are of an inviting appearance, of a light, shivering texture, and of a soft white and reddish hue. Their smell is not unlike that of a warm crab or lobster." The mouth waters, writes Dr. Johnson, at the liquorish description, and I daresay that sea anemones are not less a luxury than the sea urchins of the tasteful Greeks, or the snails of the Roman epicures, but I have not been tempted to test its truth. Rondelatius, having, as I think, Actinia crassicornis in view, is an older witness to its daintiness, and he tells us that it brings a good price at Bordeaux: "Ils la lavent fort et souvent, puis la fricassent legérèment en la poele." Actinia dianthus also is "good to eat," quoth Dicquemare; and Plancus directs the cook to dress this after the manner of dressing oysters, with which it is frequently eaten. Even the hot and peppery anthea has its praise; from it they prepare the dish called *Rastegna*, which is a favourite in Provençe.

Mr. Gosse, in his "Naturalist's Rambles on the Coast of Devon," a most delightful work which all who can should possess, goes much further, and gives every detail necessary for the preparation of an appetising dish of Crassicornis. In our next communication, with the kind permission of the author, we propose to give the paragraph in *extenso*.

JAPANESE miners have some curious customs which sadly depreciate the value of their work. They do not appear to appreciate the fact that "time is money." An engineer who has just returned from the mines of that country tells the *Engineering and Mining Journal* that they light them in a peculiar manner. Every man entering the mine carries with him a large bundle of from 5 ft. to 6 ft. of bamboo cane, slightly beaten before use. This cane is used as a torch. It burns fairly well for a few seconds, until a knot is reached, when the light nearly goes out, and the ashes must be knocked off, a process which must be repeated every half-minute. Every six or seven minutes a new cane must be lighted, so that a good share of the miner's time is occupied in keeping his illumination in a fairly satisfactory condition. Unfortunately Japanese miners are, besides, great smokers, and they use a pipe having a bowl the capacity of which is equal to that of an ordinary thimble. It takes two whiffs to finish it, when the process of filling-up and lighting it must be gone through. Everyone has probably had occasion to watch the great deliberation with which an average Irishman, when at work, will fill his clay bowl when the foreman's gaze is not on him, but imagination simply shrinks from the task of picturing the rapid progress of work intrusted to a smoking Japanese miner.

Reviews.

MIRACLES.*

SIR EDMUND BECKETT considers that Professor Huxley's restatement of Hume's well-known argument against miracles, with corrections and improvements, requires an express answer; and he gives a very express answer to it in the small book before us. He first considers the case of Huxley *versus* Hume, and then the case of Hume, Huxley and others *versus* miracles. As might be expected of so staunch a *laudator temporis acti*, Sir Edmund Beckett becomes counsel for the defendant in both cases. In the former he makes rather too serious an attack on Professor Huxley's remark that "*in reality* the definition of a miracle as a violation of the laws of Nature is an employment of language which on the face of it cannot be justified." For Professor Huxley is here only asserting what, if we wished to be precisians in language, we should regard as the true meaning of the word Nature—viz., that which is, "the sum of phenomena presented to our experience; the totality of events past, present, and to come." Of course this definition would settle the whole question of the possibility of the supernatural very simply; but for our own part we cannot find that Professor Huxley means this definition otherwise than as what *ought* to be, not what *is*, the accepted meaning of the word Nature; he nowhere lays stress on the perfectly obvious inference from this definition if it *were* the accepted one, which it certainly is not †

Sir Edmund Beckett disposes very effectually of the feeble explanation of certain miracles described in the New Testament as events which really occurred, but were perfectly natural. He leaves unnoticed the argument based on the facts that (1) identical events are related as having occurred in much earlier times, and (2) at first they were so related in direct association with a well-known Nature myth. Yet, in the present position of the subject, it is to this point chiefly that the advocates on either side should direct their attention.

It is indeed rather difficult to understand for whom this work is intended. Those on one side take a certain view which those on the other side are bound to believe that they must not take; "and so," to use Sir Edmund Beckett's own words about a similar case between Protestants and Roman Catholics, "argument is useless."

Yet like everything else of Sir Edmund Beckett's writing the book is well worth reading. Of course, there is an assumption throughout that those against whom he is arguing are not only mistaken but know they are, and that their whole argument is almost too obviously worthless to be worth answering. But though coloured with this affectation, the "pleading" is capital from first to last. It may convince no one who holds at the outset the contrary view; but it will interest and please many of them.

* A Review of Hume and Huxley on Miracles, by Sir Edmund Beckett. (London: Society for Promoting Christian Knowledge.)

† In a clever note, our author takes to task those who object to the use of the word "Infidel" by Christians, "when Christians are called so in Turkey." He says rightly enough that words should be used in England as everybody in England understands them. He conveniently overlooks, however, the fact that the objection to the word Infidel as used by many, is precisely that while its use is justified on the score of its etymology, common usage has given to it a force which is not justified in ninety-nine cases out of a hundred where it is used. The word Infidel, say many of those on whose behalf Sir Edmund pleads, means one who does not believe in sacred truths; such and such men do not believe in what I hold to be sacred truths: I may truly call them Infidels; it is not my fault if common usage gives to this term a different significance, and makes it nearly akin to Miscreant. No one cares to see the word Infidel restored to its true significance: it is the wrong application of the word in its accepted significance to those whom it only fits in its etymological significance which is objected to, and with excellent reason. So again of the word "Religion." "Some writers of that school" (Sir Edmund Beckett does not say what school) "tell us that Religion has nothing to do with a belief in God, because it may mean something else etymologically: we might as well tell them that they have no right to use 'gravity' for universal attraction, though every educated person understands it so. Such writing is mere folly, if it were not done for mischief and delusion." But the real trouble is very different. It is that many of Sir E. Beckett's school (we suppose), when they come across some who are wanting in Religion regarded in the accepted way as a belief in certain doctrines, choose to speak of them as if necessarily wanting therefore in Religion as the word is etymologically interpreted, that is, as necessarily without the binding influence of any restraint from wickedness and immorality. It is a matter of little moment whether the word Religion is understood to mean belief in a future life (say) or that feeling which keeps men from wrong doing: but it is a mistake worth correcting, because it is a gross injustice, when men use it both ways (netting with it first and spearing with it afterwards), saying, Such a man has no belief in such and such doctrines; that is he is without Religion; and therefore, since Religion means etymologically what keeps men back from evil, he is ready for all manner of evil-doing. Thus the word Infidel when justified in its etymological sense is unjustly applied in its familiar and very different sense; while, *per contra*, the word Religion when justified in its familiar sense is unjustly applied in its etymological sense. Such speaking "is mere folly, if it were not meant for mischief and delusion."

SOME CHRISTMAS WORKS.

MESSRS. GRIFFITH & FARRAN publish some charming works for Christmas time and for Christmas presents. Amongst them we note Keble's "Evening Hymn," beautifully illustrated; Edgar Poe's "Raven," a charming edition; "Nora's Trust; or, Uncle Ned's Money," a tale of the work-a-day world, by Mrs. Gellie (M.E.D.), a capital story for girls; "Middy and Ensign," by G. Manville Fenn, meant for boys, but very interesting reading for grown folk; "Paddy Finn," by W. H. G. Kingston, like all his books for boys, excellent; "Chums," a story for youngsters, by Harleigh Severne (illustrated by Harry Furniss); "Punch," by Miss E. C. Phillips; "May to Christmas at Thornhill," by Mrs. D. P. Sanford, very prettily illustrated; "A Christmas Pudding for Young Eaters," by L. C. Skey; "Lily and Her Brothers," by C. E. L.; "Growing Up," by Jennett Humphreys; "Friends, though Divided," a tale of the Civil War, by G. A. Henty, and "From Cadet to Captain," by J. Percy Groves, both well worth reading by older persons than they are written for; and "The Court and the Cottage," by Emma Marshall, whose only fault is that it ends so sadly that many young people are likely to cry over it. The following are among the books for children:—"The Fool's Paradise," "Mirth and Fun for Old and Young" (very good indeed), "Holly Berries and Holly Series," by Ida Waugh.

TELEGRAPHING CHINESE.—Owing to the peculiarity of the Chinese characters, each of which represents a word, not a letter, as in our western tongues, the Danish Telegraph Company (the Great Northern) working the new Chinese lines have adopted the following device. There are from five to six thousand characters or words in the ordinary Chinese language, and the company have provided a wooden block or type for each of these. On one end of this block the character is cut or stamped out, and on the other end is a number representing the character. The clerk receives a message in numbers and takes the block of each number transmitted and stamps with the opposite end the proper Chinese character on the message form.

Editorial Gossip.

A great pressure on our space this week causes several promised papers to be delayed till next week's number.

I hereby return my thanks to the full audience which greeted me so pleasantly on Monday at the Town Hall, Kensington. The hall is a magnificent room for speaking in; I have never known any where the management of the voice was easier. Those who have not spoken much in public can hardly imagine what a difference the acoustic properties of a hall cause. Where speaking is easy, the thoughts flow more readily, and all that the lecturer has to do is made easier to him, and the lecture pleasanter in every way to the audience. On Tuesday, when I addressed a large audience in the Rink Hall, Blackheath, I felt the difference in a very marked degree. Speaking in a long low room with a slant roof differs as much from speaking in a room like the Town Hall, Kensington, as shouting through a speaking-trumpet differs from parlour converse. Imagine the effect of trying to explain, reason, sketch, and in passing make light jests, through a speaking-trumpet.

I wonder how often during a lecture I ought to state that not the theory running through the lecture should be chiefly considered, but the facts which the theory is intended to associate together, and in some degree to explain. I very carefully noted this in my first lecture at Kensington, yet in the kindly notice which appeared on Tuesday in the *Daily News* the circumstance is overlooked, and my lecture described as though intended to advance and support certain theories.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

ORDNANCE MAP MEASUREMENTS.

[1002]—Apparently, our retrenching Government out-parallaxes "Parallax" and not only holds earth is flat, but that it is flat as pancakes or paper maps, and that hills and dales are mere illusions.

Certain officials have certain allowances when at work beyond a specified distance from home. A Parliamentary Return actually defines this to be "by the nearest available route," which seems fair common sense.

But "some Treasury *Hampden*, born to blush unseen," has discovered that a simpler way to measure is by a pair of compasses, so that not only does the Treasury calculate these terrestrial distances irrespective of roads, but irrespective of ups and downs, as though the people's servants could travel through air like the proverbial crow. The official proof of the accuracy of this method lies in the fact that it docks certain coins; but as I trow even the Lords of the Treasury can neither buy nor sell land on this style of measurement, can you tell us any other cases in which this style has place? Is it not a fact that in measuring from an ordnance map a surveyor or other person skilled in map-reading takes into account the contour as shown by the lines which give rising ground according to their distance from each other? Or, to put it more succinctly, given two points on opposite sides of Snowdon, can the distance common-sensibly be reckoned as from point to point through the hill, instead of round the base or over the top?

E. H. O.

SILENT LIGHTNING.

[1003]—I was once witness of a very exceptional case of silent lightning during the day. Many years ago I was visiting a friend at the village of C——, in this neighbourhood, and distant from the large town of D—— some ten or eleven miles, and which can be seen in ordinary weather clearly from C——. About six p.m. on this summer evening, while the landscape in the neighboorhood of C—— was bathed in sunshine, I happened to look towards D——, and saw a very black cloud enveloping it. In the face of this cloud I distinctly saw repeated tongues of spiral-like flames, rising as if from the ground, but I heard no sound. The display was very magnificent, the bright flashes showing very well on the background of the dark cloud.

Next day the papers recorded that a violent thunderstorm had taken place at D——, on the evening of the previous day. From this I would conclude that while the *intensity* of light waves is not diminished by distance, that of sound waves becomes, within a short distance, wholly inappreciable by human ears. Senex.

LUMINOSITY OF PLANTS AND ANIMALS.

[1004]—One evening some years ago, when staying near the village of Shepperton, in Middlesex, a friend asked me to come out to look at some kind of worm, which was giving light in the road. It proved to be a centipede, like that described in Knowledge, No. 104, p. 263, which is, I believe, called *Scolopendra electrica*, and left on the ground over which it was crawling a slightly luminous trail for some distance behind it.

On another occasion, when walking on cultivated sandy soil near the seashore, I found that a number of bright spots appeared on the ground wherever my feet had been in contact with it. It being too dark to see what produced this luminous appearance, I carefully removed some of the soil in which were these bright spots, and on washing it afterwards, found it contained a few small earth worms, which, when gently touched or pressed, emitted light in the dark.

The following short extracts from Phipson's interesting little book, "Familiar Letters on Some Mysteries of Nature," will, I have no doubt, interest many of your readers:—

"In 1762, Elizabeth Christine Linné, daughter of the celebrated Swedish naturalist, discovered that certain flowers emit light just after sunset."

"The plants which have been found conspicuous in this respect are the nasturtium, the sunflower, various garden marigolds, more especially the double ones, the two species of tagetes or Rose de l'Inde and Œillet d'Inde, the yellow lily (*Lilium bulbiferum*), and the tuberose."

"The phenomenon is seen in July or August after fine, dry weather, and soon after eight in the evening."

"It only occurs in dry weather, and is visible for about half-an-hour after sunset. After a rainy day, or when the air is damp, it never occurs."

"Professor Fries observed the phenomenon on a group of poppies (*Papaver orientale*), three or four flowers of which emitted little flashes of light."

"The light of these plants does not appear to be referable directly to the production of electricity, but more probably to a peculiar principle, that I have termed Noctilucine, which is produced by luminous animals."

"The common earthworm in October, and the *Scolopendra electrica*, or luminous centipede, in September, are often seen in a highly luminous state in this climate."

"In all these luminous animals, the researches of Ehrenberg and many other distinguished naturalists have shown the existence of certain organs specially adapted for the production of light."

"In luminous animals, these organs produce the substance which I have called noctilucine. It is a fluid nitrogenous substance, very easily decomposed, and which shines in the dark by oxidization, just like phosphorus itself."

"Whether it is taken from the glowworm, the scolopendra, or any other luminous animal, it shows the same chemical properties and the same spectrum (from E to F)."

"By luminous insects it is secreted as fast as required by nature

and as the organ by which it is elaborated is under the influence of the nervous system, these insects have the power of increasing or diminishing their light." E. C. R.

[1005]—Your correspondent, Mr. Vos, in this week's KNOWLEDGE has pictured just such an animal as was brought a few months ago by the grocer's boy in a box containing eggs, which were packed in straw. Its glowing appearance in the straw attracted attention, and it was thought to be a glowworm. On turning up the light, however, and examining it with a magnifying glass, I found it to be a kind of centipede. Putting out the light did not restore its luminosity; it appeared to have the power of emitting or withholding its light at pleasure.

Your answer to "Harry" reminds me that the self-same question was set at an examination of pupil-teachers a few months since, and, I believe, floored the greater part if not all of them. As you say, seven is not near the answer. One is apt at the first glance to overlook the fact that trains are already on the same line of rails as the train in which the "counter" starts besides those running on the return line, so that both sets will have to be met. W. W. S.

[1006]—It is a well-known fact that one or two British centipedes are luminous. The Rev. Leonard Jenyns, says in his "Observations in Natural History," p. 296:—

"Dec. 10, 1843.—A man brought me to-day what he called two glowworms, which he had seen shining on a bank the preceding evening. They proved to be only the electric centipede (*Scolopendra electrica*), which is frequent in the autumnal months in this neighbourhood (Swaffham Bulbeck, Cambridgeshire), and may often be seen shining by roadsides, more especially on mild damp evenings. They are constantly mistaken for glowworms by the common people. These two individuals I kept alive in a small box with damp earth at the bottom for several months; but I never observed them to shine once after they were taken.

"The luminosity of this insect is remarkable for diffusing itself over the ground, or the fingers of those who attempt to handle the individual from which it emanates, in like manner as when pure phosphorus is handled. I am not aware that this is ever the case with the real glow-worm." And he adds the following note: I was not then aware of the observations of Mr. Gosse, who states that he found the light might be immediately reproduced by breathing upon the centipede; the experiment fails (it is said) if repeated too often at once, though after the lapse of a day and night it will produce the same results as at first." CYPHEL.

[1007]—There is a luminous centipede, not at all uncommon; I have seen it several times.

About ten days ago, when walking in my garden in the evening, I observed something shining, and supposed it to be a centipede; but on examining it with a light, I found it to be a part of the dead body of a snail; and the night before last, on noticing a similar light, I discovered it to be a part of the body of a dead worm. I should think it was something of the latter kind that Mr. Fenton saw. The light in these cases would doubtless be caused by chemical change. J. DYER.

DISCOVERY OF AMERICA.

East Berar.

[1008]—Quatrefages, in his book "The Human Species," Chap. XVIII., on Migrations in America, writes:—"In 986, Bjarn Meriulfson, when on his way to Greenland, was carried by a storm as far as New England. In 1000, Leif, the son of Erick the Red, started for the country discovered by Bjarn. Accompanied by thirty-five men, he ran down as far as Rhode Island, where he found the vine, and gave the name of Vin-land to the country, which he took possession; he built Leifsbudir, passed the winter there, and noticed that the shortest day began at half-past seven and ended at half-past four. This observation, which agrees with all the other details, places Leifsbudir near the present town of Providence, 41° 21′ 10″, N. lat. . . . . The colonies founded in Greenland by Erick . . . . multiplied rapidly; both the east and west coast were peopled. Then two centres bore the name of Osterbygd and Vesterbygd . . . . as early as 1121, an Irishman, Erick Upsi, was created Bishop of Greenland, and had eighteen successors. Vinland was in the jurisdiction of this diocese. The tithes of this country figured among the revenues of the Church in the fourteenth century, and were paid in kind. . . . In 1418 it still paid to the Holy See as tithes and Peter's pence 3,600 lb. of walrus tusks. . . . Shortly afterwards fleets of pirates, springing from some unknown quarter, came down upon and pillaged them; the temperature of both land and sea gradually fell; voyages became more and more difficult, and, at last, ceased altogether."

In comparatively bookless India I have no resource but to ask you, is all the above true? Columbus discovered America in 1492, as if previously unknown, yet only 74 years before Vin-land paid tribute to the Pope, and all knowledge of the fact seems to have been forgotten. It would also be curious to find out the unknown quarter the pirates came from. Is it authenticated? As also is the fall in temperature, which seems extraordinary? If in 1418 there was a Bishop with Rhode Island in his diocese, can Columbus be said to have discovered America at all? EDM. B.

THREE TIMES GREATER THAN.

[1009]—My attention was lately drawn to an opinion expressed by a learned judge upon the meaning of a not uncommon phrase, occurring in a certain Statute, namely, "three times greater than," which phrase his lordship held to be synonymous with the expression "three times as great."

Counsel argued that if (as was the opinion of the judge) $4\frac{1}{2}$ was three times greater than $1\frac{1}{2}$, then 3 would be two times greater than $1\frac{1}{2}$, and $1\frac{1}{2}$ would be one time greater (!) than $1\frac{1}{2}$; but he failed to convince the judge. The same argument, if inverted, seems ever more forcible; for instance, granted that "$\frac{1}{2}$ (or, indeed, any fraction) greater," would represent an increase of size over the object compared with, then "one time greater" must mean double the size, "two greater" treble the size and so on.

The case referred to is to be found in No. 22, "Justice of the Peace," p. 431. A. ROGERS WOOD.

CONTRACTED MULTIPLICATION.

[1010]—

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      71·380164 × 2·7354
           2·7351
      ─────────────
      214140492   = product by 300
    1927261428    = 3 × 9 = 27000
       3851528856 = 2 × 27 = 54
    ──────────────
    195·2533006056
    ──────────────
         27·14986 + 92·41035
    Reverse the multipliers.
         27·14986
          5301429
         ────────
         21434874
           542997
           108599
             2715
               81
               14
         ────────
         2508·9280
```

[Viz., circ. 50 digits against 74 digits in a short sum.] First shown to me by Prof. Steggal, of the New University College, Dundee. Did Prof. Henrici mean this? (From "Young's Arithmetic.")

By the way, have you noticed how much one wants a comma, aye, and a red one, in the second Collect at evening prayer: that *both*, our hearts, &c., &c.? FACIEBAT.

DOUBLING OF POPULATION, CAPITAL, &c.

[1011]—$\frac{70}{r}$ is a simpler (though less close) approximation to the value of n than the formula $\frac{208+r}{3r}$ given at p. 262 [972].

The difference between the values given by the two formulæ cannot exceed $\frac{1}{3}$, and is 0 when r is 2. G. O. E.

OBSCURE CAUSES OF DEATH BY DROWNING.

[1012]—It has often happened to me (as to all swimmers, I suppose) to swallow a mouthful of salt water, in spite of every care not to do so. I have also often been near swallowing some small object—a bit of cork or wood, a *blob* of bladder-wrack, &c. Now, it might happen that such a thing wedged itself in the windpipe, producing suffocation. The doctors finding that the cause of death, would never think of cutting open the throat in search of the cause, supposing the water sufficient. But may not some such accident account for the many cases where good swimmers have perished without any exhaustion to account for it? It might be prudent to wear a net tied over the mouth. Also lives might be saved if men when swimming far had a small flask of brandy round

the neck. Sudden failure of the heart's action could then be met by a pull at the stimulant, which is also an antidote to cramp.

HALLYARDS.

[A mouthful of salt water, catching in the throat—*i.e.*, not swallowed but taken in in breathing—may cause even the best swimmer some trouble. Last summer bathing from a boat, and happening to speak at the wrong moment to the boatman, I was caught that way—and if he had not happened to look my way, I might have been drowned close by him. For I could not call out, nor breathe except by gasps—which would not have done in the water. Fortunately he saw my signals of distress, and shoving an oar under me, gave me a chance of gasping my breath back.—R. P.]

STORM-GLASS.

[1013]—If of any use to your correspondents, the following recipe for a "storm-glass" is extremely simple and reliable.

Take a wide-mouthed glass bottle (say about five inches high), fill it with water till within an inch of the neck, or three parts full; then take a small empty oil-flask, turn it upside down, and insert it in the mouth of the glass bottle, filling the interstice with a piece of cork so as to be air-tight; the neck of the flask will then be under the water, which will rise or sink in it with the pressure of atmosphere, as in an ordinary barometer.

E. BROWN.

SETTING UP CHESSMEN.

[1014]—Recently in conversation the question arose whether it was probable that, at the commencement of a game of chess, *all* the pieces were ever before on exactly the same squares? One or two thought it not unlikely. Now, without reversing the board, the White Pawns may be arranged in $|\underline{8}$, that is, 40,320 different ways. For each one of these positions, the Black Pawns can also be arranged in 40,320 ways. Thus there are $10,320^2$ or 1,625,702,400 ways of arranging the Pawns. Again the superior pieces may be arranged in 64 different ways. Finally, the board can be reversed. Thus there are in all $(|\underline{8})^2 \times 64 \times 2 = 208,089,907,200$ different ways in which these mimic forces may be put on the board in order of battle.

Suppose we play 100 games each day, it would thus take any one more than five million years to exhaust all these possible positions.

Judge, then, how little an affirmative answer to the original question is likely to be true.

D. M.

SOFTENING WATER.

[1015]—Letter 954, signed "Lewis James," asks for information as to the process by the Atkins Apparatus mentioned in the Guide and Catalogue of the great International Fisheries Exhibition. Application at 62, Fleet-street, London, E.C., the offices of the Company, will procure him full particulars on the softening and purifying of water for all purposes and in any quantity for constant supply.

Allow me to add that the discovery of lime treatment to soften water was made by the late Dr. Clark about forty years ago, but then too costly to apply to waterworks. The Atkins mechanical process overcomes this and many other difficulties, thus rendering Dr. Clark's discovery of great value in the supply of softened water to every community at a very small cost, with an immense saving in every household. Dr. Clark's discovery is now public property, and the application of it depends entirely on the inventor of economical machinery for its universal adoption. For years I have been interested in the treatment of water, and I do not hesitate to state that the Atkins Apparatus is the most simple I have seen, and in this opinion I am not alone.

C. E. PARKER-RHODES.

Oct. 18, 1883.

LETTERS RECEIVED AND SHORT ANSWERS.

JOHN SIMPKIN. You will see that I am very much with you about imaginary mathematics.—AN ADMIRING READER. Is it ungrammatical to say, "I have done with you"? And if not, is it wrong to say, "This is done with?" I do not say it is not; but the expression is familiar.—JULES MAGNY. 1. No. I have not yet published an article showing how the year may have first been measured by the seasons. 2. The gnomon was used in the way you indicate, that is by observing shadow lengths. This was done probably much earlier than 1100 B.C. 3. Do not know enough about cells and their action to answer this question, though the fact is as you say. 4. Articles on the different systems of drawing geographical maps would be very much in my line, and (if readers interested) may probably soon be given.—F. BATTERSBY. Thanks; it seems clear beech nuts have often kernels.—C. T. BUDENBERG. Would indeed that everything printed were true! Have as you see used that startling Tit-bit.—W. B. S. That theory about sun spots is not strictly new. It was first suggested by Scheiner in 1611, and the bodies supposed to travel round the sun were called Bourbonian Stars.—J. W. DAWSON. Have not the book and cannot therefore tell you the publisher's name. It is I am told a capital work.—180° LONGITUDE. But, *lessening* west longitude means running east. Of course with the new way of reckoning longitude adopted by the Geodetic folk your difficulty would not exist.—B. WALKER. If any feel animosity or rancour about such matters it is a pity, but really need not much interest "us." Why should the truthful tone of the articles you mention need counterbalancing?—PLYMOUTH HOSPITAL. Can you conceive of no other mode of genesis than that first sketched in the nebular hypothesis? Now *I* can. That mode of genesis seems to me contradicted by numerous facts chiefly learned since Laplace's time.—AN ENQUIRER. Many known cases of seeming identity of thoughts in persons at a distance; but it seems most probable they are cases of coincidence. Mr. Labouchere would say, Certainly they are so, because he knows all about thought. But there are more things in heaven and earth than are known or even guessed in *his* philosophy.—THOS. COWLDESTH (or COWHERTY, or CONLOERTHZ, or COWTOESTHS ? ? ?) No; have discovered no such correction; but would willingly hand you a cheque for a considerable amount (any you please) if you could in less than five minutes or in over five million, solve the fifteen puzzle *as propounded*,—viz., having the numbers 1, 2, 3, 4 in that order on first line, 5, 6, 7, 8 on next line, 9, 10, 11, 12, on third line, 13, 15, 14 on the fourth line, bring them by fair shifting without lifting, so that the same numbers are in the same places in the first three lines, but the numbers 13, 14, 15 *in that order* on the fourth line. It is the easiest thing in the world to get the numbers in regular rotation, from any order they may be set in, but to get them arranged in their proper places according to the actual conditions of the problem is impossible outside of the imaginary universe we have recently heard so much about. The Thirty-four Puzzle is simplicity itself: the difficulty is to miss the solution.—JAS. MCKEAN. Do not know anything about the matter myself, or would tell you.—J. F. MOULT. Thanks; but fear our readers would not be grateful for your new proof that a man may be his own grandfather. Of course if father and son marry respectively daughter and mother, the son, being step-father of his father's wife, is his father's step-father-in-law, or his own step-grandfather-in-law. If you enjoy puzzles of this sort, wander into the following maze, and see what comes of it:—John Smith a foolish young fellow of seventeen falls in love with, and marries, Mrs. Brown a fair widow of fifty, who having married at sixteen has a daughter of thirty-three, who also marrying young (it ran in the family you see) has a daughter of sixteen, Miss Robinson. Thomas Smith, John's grandfather, a lively youth of fifty-five summers, smitten by Miss Robinson's charms, marries her, while James Smith, Thomas's son and John's father, marries the charming Mrs. Robinson. Consider the various relationships among these folk. And if you remain outside Colney Hatch, let a few brothers and sisters of Thomas, James, and John, intermarry *ad lib.* with sisters and brothers of Mesdames Brown, Robinson, and J. Smith, *née* Robinson. Then consider their relationships and those of children born to these various couples. Make your will first, as it might be disputed if made later.—GARETH. I know little about the *modus operandi* of mesmerists; and think I would rather not have the subject dealt with in these pages. Though I know many of the phenemena to be real enough, they have been associated with so much humbug that they do not form an inviting subject. The most satisfactory experiments in beginning are those made on animals, especially pigeons, which are very susceptible to hypnotic treatment.—M. H. CLOSE. Thanks. I was, however, aware of the pronunciation of the word *maise*, which, as I said, to an uncritical ear is something like that of the word "masher." As you say the fact that the word *maise* means also "an ornament," and "food," is another very strong argument against the absurd derivation of "masher" from "maise."—ALEXANDER CROSS. Thanks; the duke's lecture amusing truly. Fancy the general flood leaving its neat but unique mark in Wales!—CHEESE CONSUMER. The *origin* of cheese mites! Do we know the origin of anything? The Natural History of cheese mites *might* be managed.—G. B. R. BOUSFIELD. Smyth's *Cycle* gives a number of those names. So do some old globes. I may shortly give a weekly list of them in these columns. W. HOLMES.—Is the word *Agnostic* so unfamiliar? It is given in the supplement to Webster's Dictionary. The word *Gnostic* means one who claims to know, while the word *Agnostic* means one who admits that he does not know. Usually the matter referred to as known or not known is the nature of Deity. You will find that there were Gnostics and Agnostics in very ancient times. I am inclined to think that Zophar who said "Can'st thou by searching find out God," and Elihu who said "The Almighty, we cannot find him out," were Agnostics.

UNCERTAIN. No, sir; I deny utterly the aptitude of your illustration. You cannot divide the world into the two classes you represent by the bitterly-weeping upbraiding multitude and the non-starving folk at their dinner-table. We are *all* of the multitude. "Every soul that cometh into the world" has to deal with the great problem for himself, even if only in deciding that he will accept the judgment of others about its solution. I am not prepared to admit that indifferentism arises generally or often from engrossment in lower pursuits. I should say it arose in ninety-nine cases out of a hundred from the conviction that only misery to self and others can arise from care about phantasms. Then, what *are* lower pursuits? I expect you mean such pursuits as ninety-nine out of a hundred must engage in if they are to live. I might in your own tone answer, what God has thus given to men to do is but idly condemned as low; what His will has sanctified "that call not thou common or unclean." But why ask me what I think? In what way has the great problem come before me otherwise than it has come before every one living now and in the past or to live hereafter? Men come to me and say, what do you think in these matters? I answer what matters it to you what I think? What right have you to ask? I do not seek to know what *you* think. Then comes the answer, Oh, but you should want to know; such indifference is selfish; and though we do not, for the moment, say what *we* think, we are not selfishly indifferent like you: tell us your views. If, thus urged, I answer I think so and so, immediately ninety-nine out of a hundred say That's not the way *we* think; you ought to think thus and thus; and if you don't think thus and thus, you ought to hold your tongue, or else [and this I take it is what most of the inquisitive sort desire] you should solemnly assert that you hold the particular views which we, Messrs. Meddlesome, Pry, and Puzzlewit, consider to be right. When there comes along a plain and honest teacher who says, Amidst much that is perplexing I see one clear line of duty; strive in every way to make yourself and all around you as happy (both by increasing their pleasures and diminishing their sorrows) as you possibly can, and make your success the measure of the rightness of your life-conduct, then because there is no phantom-hunting *here*, the whole fry of phantom-hunters accuse him—of all men—of indifference.

Our Whist Column.

By "Five of Clubs."

A WHIST STUDY.

On consideration, instead of giving this week the Whist game referred to in our last, we prefer to give the position at the end of the eighth round, in order that our Whist readers may have an opportunity of studying how the hand should have been played by *Z* to save and win the game, and may further appreciate the beauty of the combination which enabled *A* and *B*, taking advantage of the opening left them by *Z*, to save an apparently lost game.

The cards lay as follows:—

Y held. *Diamonds.*—K, 9, 7. Club.—8. Heart.—Kn.	*B* held. *Diamonds.*—A, 10, 8, 3. Club.—5.
A held. *Diamonds.*—4, 2. Clubs.—Kn., 10, 7.	*Z* held. Hearts.—7, 6, 5, 3. Spade.—Kn.

It was *Z*'s lead, and *A* and *B* must make every trick to win and save the game. *A* the original leader had shown by leading the penultimate that he held five Clubs, of which three remain in his hand. This is known to the whole table. *B* had signalled for trumps, and from the play it is clear that he now holds four trumps one honour. Moreover this honour must be the Ace or the game is lost. *A* further knows that his partner holds trump Three. *Z* knows from the play that *A* holds both Four and Two of trumps. He also knows that the Knave of Hearts is with his partner, and that *Y* holds a Club which if the winning Club insures the game. The game is also sure if *Y* holds the King and Ten of trumps.

1. How is *Z* to play to make sure of winning, if *Y* play correctly, even though *Y* shall be found to hold a losing Club, but with either King or Nine, or Ten Nine of trumps besides a small one?

2. *Z* actually led a Heart; how can *A* and *B* now save and win the game?

Our Chess Column.

By Mephisto.

SUI-MATE PROBLEM, No. 103, BY E. N. FRANKENSTEIN, p. 281.

POSITION:

White.—K, QKt2. Q, QBsq. R's, K2 & KR6. B, QRsq. Kt's, Q4 & QKt6. P's, QKt3 & QR5.
Black.—K, QB4. Q, QR3. B, KR6. P's, QKt5, QB5 & Q4.

SOLUTION.

1. Kt to R4 (ch)	1. K takes Kt
2. K to B2 (ch)	2. P to B6
3. R to R4 (ch)	3. B to Kt5
4. Q to Q2 (ch)	4. Q to Q6
5. K to Qsq!	5. Q takes Q (forced) mate

THE following interesting game was recently played in the Handicap Tournament now in progress at Pursell's Chess Room, at the odds of Pawn and move, between Mr. Heppell, third class, and Mr. Gunsberg, first class.

Remove Black's King's Bishop's Pawn.

White. Heppell.	Black. Gunsberg.	White. Heppell.	Black. Gunsberg.
1. P to K4	Kt to QB3 (*a*)	17. P to K4 (*p*)	P takes P
2. P to Q4 (*b*)	P to Q4 (*c*)	18. QKt to Q2 (*q*)	P to K6 (*r*)
3. P to K5	B to B4 (*d*)	19. Kt takes P	B to Q6
4. Kt to KB3	P to K3	20. Q to B2	B to R3
5. P to QR3 (*e*)	KKt to K2	21. B takes Kt (*s*)	P takes B
6. Kt to R4 (*f*)	B to K5 (*g*)	22. Kt to Kt2	KR to B sq
7. B to KKt5	P to KR3 (*h*)	23. Kt to B4	R takes Kt (*t*)
8. B to K3 (*i*)	P to KKt4 (*j*)	24. P takes R	R to B sq (*u*)
9. Kt to KB3	Kt to B4	25. KR to B sq (*v*)	R takes P
10. P to B3 (*k*)	P to Kt5	26. Q takes R	B takes Q
11. KKt to Q2	Kt takes B	27. R takes B	Q to R3 (*w*)
12. P takes Kt	B to KB4 (*l*)	28. R to B sq (*x*)	Q to K6 (ch)
13. P to Kt3	Q to Kt4	29. K to Q sq	B to K7 (ch) (*y*)
14. Q to K2	P to KR4	30. K to B2	Q to Q6 (ch)
15. B to Kt2	Castles (*m*)	Resigns (*z*)	
16. Kt to B sq (*n*)	Q to Kt3 (*o*)		

NOTES.

(*a*) We think this one of the most reliable defensive moves at Black's command.

(*b*) As it obviously is Black's intention to play P to Q4, White might play 2. QKt to B3. We fancy that a simpler game would be the result. If then Black replied with 2. P to K4, White could play 3. P to B4 with good effect.

(*c*) Better than 2. P to K4, although the latter move will, if not properly met by White, result in an attacking game for Black. In reply to 2. P to K4, White ought to play either 3. P to Q5, followed by 4. P to KB4, or perhaps better still 3. Kt to KB3.

(*d*) It is important to release the QB before playing P to K3.

(*e*) This move gives Black time for development. It would have been better to oppose Bishops at Q3.

(*f*) Again loss of time. Steinitz said you should never without good reason move a piece twice early in the game.

(*g*) The B was not to be denied. B to K5 is a move of considerable power, to which White had no satisfactory reply. The combinations based upon this move are interesting. If, for instance, 7. Kt to QB3, Kt takes QP. 8. Q takes Kt, Kt to B3, recovering the piece *plus* a Pawn next move by Q takes Kt. Or, if 7. P to KB3, Black could play the quiet move of Kt to B4, which would leave him with a good position. He could not venture upon the bold but tempting course of sacrificing a piece, as White by proper play would remain with the best game, *i.e.*, 7. P to KB3, B takes QBP. 8. Q takes B, Kt takes QP. 9. Q to R4 (ch) (best), KKt to B3. 10. P to KKt3, P to KKt4. 11. B to K3 (best), B to B4. 12. B to QKt5, and White wins.

(*h*) This move further improves Black's game. No good would result from the check with the Queen, *i.e.*, 8. Q to R5 (ch), K to Q2, and White must either lose a Pawn or give up two pieces for the Rook and another Pawn (which would be preferable) by playing 9. P to QB3, P takes B. 10. Q takes R, P takes Kt. 11. Q takes P, &c.

(*i*) 8. B takes Kt, B takes B. 9. Kt to KB3, B takes Kt. 10. P takes B, would have been more favourable to White than B to K3.

(*j*) Taking a forcible advantage of the position.

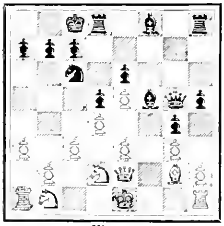
(*k*) 10. Kt to QB3 would have been a stronger move.

(*l*) If, instead, Q to R5 (ch). 13. P to Kt3, Q to Kt4. 14. Kt takes B, Q takes KP (ch). 15. Q to K2, Black would lose all his

advantage, he being compelled to play Q takes Kt, upon which an exchange of Queens would follow.

Position after Black's 15th move.

BLACK.



WHITE.

(*m*) White threatens to free his position by playing P to K4, in which case Black need not take the P, but would retire B to Kt3, and the position would remain unaltered. It would have been different had Black, instead of castling, played the likely-looking move of B to R3, for then would follow 16. P to K4, P takes P. 17. Kt takes P, B takes Kt. 18. B takes B, with the better game, as the check with Q on B8 is useless on account of K to B2, &c.

(*n*) With the object of bringing the QKt into play, then P to K4, &c., and with a view to castling QR. It would have been too risky to castle on the K side on account of P to R5, &c.

(*o*) Threatening the Knight, but in reality B to Q6.

(*p*) The best resourse; White could not allow B to Q6 to be played, which would have been followed by B to R3, R to B sq, &c.

(*q*) This looks good as it at once recovers the Pawn, but, as will be seen, appearances are often delusive. White would have done much better by playing Kt to K3 first. Undue haste is equally injudicious in defence as well as in attack.

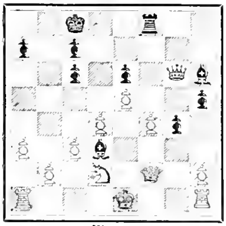
(*r*) The sacrifice of this Pawn maintains all the advantages of Black's position.

(*s*) Castling would have been the lesser evil.

(*t*) This sacrifice sustains the attack. B takes Kt would have won a P, but might have led to an even game.

Position after Black's 24th move.

BLACK.



WHITE.

(*u*) The position is now singularly interesting. If White plays 25. Castles, then follows B takes P. 26. P to Kt4, B to Kt8, and mates in two moves. Or, if 25. Q to Kt2, R takes P. 26. Q takes BP, B to K5. To avoid the loss of the R, White must play 27. Kt takes B, after which Black can force the game in the following manner:—R takes Kt (ch). 28. K to Q sq (best), R takes P (ch). 29. P takes R, Q to Q6 (ch). 30. K to K sq, B to Q7 (ch). 31. K to B2, B to K6 (ch). 32. K to Kt3, B to Kt4 (dis ch). 33. K to B2, B to R5 (ch). 34. K to Kt sq, Q to K6 (ch), and mates next move.

(*v*) In the hope that Black would lessen his attack by playing B takes R.

(*w*) The winning move. Black relied upon this move, as otherwise he need not have allowed White to exchange his Queen.

(*x*) There is nothing better to prevent the threatened mate by Q to (K6, K7 and K8 (ch).

(*y*) Moderation is advisable not only in attack and defence but also in victory, as it renders it more decisive. This is better than taking the Rook at once, as that would only win the exchange, while now Black wins a clear piece.

(*z*) Duration 2 hours 40 minutes.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

F. W. Markwick.—Problems received with thanks, and will receive due attention. A capture on first move is to be regarded less seriously in two moves than in Problems of a higher number of moves, provided always it does not make the solution too obvious.

S. B. B.—Hardly a week passes without somebody asks us the same question over again:—"Can you recommend me a book on the openings?" The only two good books we know of, and which we could honestly recommend, "Cook's Synopsis" and "Gossip's Theory," are out of print. Books like "Staunton" and "Wormald," which were good books in their time, are somewhat out of date now. Other books which are still in print were compiled by dishonest men—that is, persons who either for their own vain glory or profit —it does not matter which—produced a mass of worthless Chess literature to the disadvantage of the public, publishers, and abler workers—a proceeding which is constantly being supported by the Chess press, whose representatives really belong to the same snug family party. Until editors and publishers will replace these usurpers by honest and able workers, the public will not get satisfied, and Chess will not be raised to the proud position our noble game deserves to hold among our national pastimes. Compared with cricket and other sports it is comparatively little known. As you only wish to know the Vienna and French defence, we should recommend you—for want of anything better—to apply to the "British Chess Magazine" for any numbers that might contain analyses of these openings.

B. G. Laws.—Accept our best thanks for review, no space this week.

Rev. W. Anderson.—In problem 104, B to Kt. 3 does not even threaten a mate. Black could reply B to B2 or R2.

J. K. R.—If 1. P to K3, then P to K4; 2. K to Kt4, B to Q3, and you see there is no mate.

A Conrad Smart.—Your notation is, unfortunately, indistinct.

Berrow.—You have likewise been deluded by this ingenious composition, see reply to I. K. R.

M. T. Hooton.—Hesperus correctly solved. In No. 101, if Kt takes P, then K to Q4, and there is no mate. Problem 104 correctly solved by Clarence and Schachrath.

MR. R. A. PROCTOR'S COURSE OF LECTURES.

1. LIFE OF WORLDS.	4. THE PLANETS.
2. THE SUN.	5. COMETS.
3. THE MOON.	6. THE STAR DEPTHS.

See Advt. Pages for full Syllabus.

The following arrangements are complete: the numbers in brackets referring to above list.

Great Hall, Tunbridge Wells, Nov. 20, 22 (4, 5).
Concert Hall, Maidstone, Nov. 19, 21, 23 (1, 2, 3).
Stockton, Nov. 26 (1).
Edinburgh, Nov. 28 (6).
Rotbesay, Nov. 29 (1)
Morningside, Dec. 4 (4).
Falkirk, Dec. 5 (6).
Alexandria, Dec. 6.
Altrincham, Dec. 10 and March 11.
Carlisle, Nov. 27, 30; Dec. 3, 7 (1, 2, 3, 4).
Perry Bar, Jan. 29 (6).
King's Heath, Jan. 30 (1).
Colston Hall, Bristol, Feb. 18, 21, 25, 28; March 3, 6 (the full course).
Assembly Rooms, Cheltenham, Feb. 5, 8, 12, 15 (1, 2, 4, 6). At 3 o'clock, Feb. 5 and 12 (3, 5).
Assembly Rooms, Bath. Four Morning Lectures at 3 o'clock, Feb. 6, 9, 13, 16 (1, 3, 4, 6); two Evening, Feb. 6, 13 (2, 5).
Birkenhead, March 10.

NOTE.—*All communications respecting Lectures should be addressed to Mr. John Stuart, Royal Concert Hall, St. Leonards.*

CONTENTS OF No. 106.

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LONDON: FRIDAY, NOV. 23, 1883.

CONTENTS OF No. 108.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXIII.

In my last I referred generally to the high nutritive value of cheese. I will now state particulars. First, as regards the water. Taking muscular fibre without bone, *i.e.*, selected best part of the meat, beef contains on an average $72\frac{1}{2}$ per cent. of water; mutton, $73\frac{1}{2}$; veal, $74\frac{1}{2}$; pork, $69\frac{3}{4}$; fowl, $73\frac{3}{4}$; while Cheshire cheese contains only $30\frac{1}{3}$, and other cheeses about the same. Thus, at starting, we have in every pound of cheese rather more than twice as much solid food as in a pound of the best meat, or comparing with the average of the whole carcase, including bone, tendons, &c., the cheese has an advantage of three to one.

The following results of Mulder's analysis of casein, when compared with those by the same chemist of albumen, gelatine, and fibrin, show that there is but little difference in the ultimate chemical composition of these, so far as the constituents there named are concerned.

Carbon	53·83	Casein.
Hydrogen	7·15	
Nitrogen	15·65	
Oxygen, Sulphur	23 37	

	Albumen.	Gelatine.	Fibrin.
Carbon	53·5	50·40	52·7
Hydrogen	7·0	6·64	6·9
Nitrogen	15·5	18·34	15·4
Oxygen	22·0	24·62	23·5
Sulphur	1·6	,,	1·2
Phosphorus	0·4	,,	0·3

We may therefore conclude that, regarding these from the point of view of nitrogenous or flesh-forming, and carbonaceous or heat-giving constituents, these chief materials of flesh and of cheese are about equal.

The same is the case as regards the fat. The quantity in the carcase of oxen, calves, sheep, lambs, and pigs varies, according to Dr. Edward Smith, from 16 per cent. to 31·3 per cent. in moderately-fatted animals, while in whole milk cheeses it varies from 21·68 per cent. to 32·31 per cent., coming down in skim-milk cheeses as low as 6·3. Dr. Smith includes Neufchatel cheese, containing 18·74 per cent., among the whole-milk cheeses. He does not seem to be aware that the cheese made up between straws and sold under that name is a *ricotta*, or crude curd of skim-milk cheese. Its just value is about threepence per pound. In Italy, where it forms the basis of some delicious dishes (such as *budino di ricotta*, of which anon), it is sold for about twopence per pound or less.

There is a discrepancy in the published analyses of casein which demands explanation here, as it is of great practical importance. They generally correspond to the above of Mulder within small fractions, as shown below in those of Scherer and Dumas:—

	Scherer.	Dumas.
Carbon	54·665	53·7
Hydrogen	7·465	7·2
Nitrogen	15·724	16·6
Oxygen, sulphur	22·146	22·5

In these the 100 parts are made up without any phosphate of lime, while, according to Lehmann ("Physiological Chemistry," vol. i., p. 379, Cavendish Edition), "casein that has not been treated with acids contains about 6 per cent. of phosphate of lime; more, consequently, than is contained in any of the protein compounds we have hitherto considered."

From this it appears that we may have casein with, and casein without, this necessary constituent of food. In precipitating casein for laboratory analysis, acids are commonly used, and thus the phosphate of lime is dissolved out; but I am unable at present to tell my readers the precise extent to which this actually occurs in practical cheese-making where rennet is used. What I have at present learned only indicates generally that this constituent of cheese is very variable; and I hereby suggest to those chemists who are professionally concerned in the analysis of food, that they may supply a valuable contribution to our knowledge of this subject by simply determining the phosphate of lime contained in the ash of different kinds of cheese. I would do this myself, but, having during some ten years past forsaken the laboratory for the writing-table, I have neither the tools nor the leisure for such work; and, worse still, I have not that prime essential to practical research (especially of endowed research), a staff of obedient assistants to do the drudgery.

The comparison specially demanded is between cheeses made with rennet and those Dutch and factory cheeses the curd of which has been precipitated by hydrochloric acid. Theoretical considerations point to the conclusion that in the latter much or even all of the phosphate of lime may be left in solution in the whey, and thus the food-value of the cheese seriously lowered. We must, however, suspend judgment in the meantime.

In comparing the nutritive value of cheese with that of flesh, the retention of this phosphate of lime nearly corresponds with the retention of the juices of the meat, among which are the phosphates of the flesh.

These phosphates of lime are the bone-making material of food, and have something to do in building up the brain and nervous matter, though not to the extent that is supposed by those who imagine that there is a special connection between phosphorus and the brain, or phosphorescence and spirituality. Bone contains about eleven per cent. of phosphorus, brain less than one per cent.

The value of food in reference to its phosphate of lime is not merely a matter of percentage, as this salt may exist in a state of solution, as in milk, or as a solid very difficult of assimilation, as in bones. That retained in cheese is probably in an intermediate condition—not actually in solution, but so finely divided as to be readily dissolved by the acid of the gastric juice.

I may mention, in reference to this, that when a child or other young animal takes its natural food in the form of milk, the milk is converted into unpressed cheese, or curd, prior to its digestion.

Supposing that on an average cheese contains only one-half of the 6 per cent. of phosphate of lime found, as above, in the casein, and taking into consideration the water contained in flesh, the bone, &c., we may conclude generally that one pound of average cheese contains as much nutriment as three pounds of the average material of the carcass of an ox or sheep as prepared for sale by the butcher; or, otherwise stated, a cheese of 20 lb. weight contains as much food as a sheep weighing 60 lb. as it hangs in the butcher's shop.

Now comes the practical question. Can we assimilate or convert into our own substance the cheese-food as easily as we may the flesh-food?

I reply that we certainly cannot if the cheese is eaten raw; but have no doubt that we may if it be suitably cooked. Hence the paramount importance of this part of my subject. A Swiss or Scandinavian mountaineer can and does digest and assimilate raw cheese as a staple article of food, and proves its nutritive value by the result; but feebler bipeds of the plains and towns cannot do the like.

I may here mention that I have recently made some experiments on the dissolving of cheese by adding sufficient alkali (carbonate of potash) to neutralise the acid it contains, thus converting the casein into its original soluble form as it existed in the milk, and have partially succeeded both with water and milk as solvents; but before reporting these results in detail I will describe some of the practically-established methods of cooking cheese that are so curiously unknown or little known in this country.

In the fatherland of my grandfather, Louis Gabriel Mattieu, one of the commonest dishes of the peasant who tills his own freehold and grows his own food is a "fondevin" (I cannot explain the etymology of the word, and spell it only by ear, never having seen it in print or writing). This is a mixture of cheese and eggs, the cheese grated and beaten into the egg as in making omelettes, with a small addition of new milk or butter. It is placed in a little pan like a flower-pot saucer, cooked gently, served as it comes off the fire, and eaten from the vessel in which it is cooked. I have made many a hearty dinner on one of these, *plus* a lump of black bread and a small bottle of genuine, but thin, wine; the cost of the whole banquet at a little *auberge* being usually less than sixpence. The cheese is in a pasty condition, and partly dissolved in the milk or butter. I have tested the sustaining power of such a meal by doing some very stiff mountain climbing and long fasting after it. It is rather too good —over nutritious — for a man only doing sedentary work.

A diluted and delicate modification of this may be made by taking slices of bread, or bread and butter, soaking them in a batter made of eggs and milk—without flour—then placing the slices of soaked bread in a pie-dish, covering each with a thick coating of grated cheese, and thus building up a stratified deposit to fill the dish. The surplus batter may be poured over the top; or if time is allowed for saturation, the trouble of preliminary soaking may be saved by simply pouring all the batter thus. This, when gently baked, supplies a delicious and highly nutritious dish. We call it cheese pudding at home, but my own experience convinces me that we make a mistake in using it to supplement the joint. It is far too nutritious for this; its savoury character tempts one to eat it so freely that it would be far wiser to use it as the Swiss peasant uses his fondevin, *i.e.* as the one and only dish of a good wholesome dinner.

I have tested its digestibility by eating it heartily for supper. No nightmare has followed. If I sup on a corresponding quantity of raw cheese my sleep is miserably eventful.

THE SENSES IN INFANTS.

I.

IT is related of a deaf and dumb mother that one night, some few days after the birth of her first child, she was seen by the nurse who tended her to rise from her couch, glide stealthily up to the hearth, take from it a ponderous lump of coal, and, with it poised aloft in her hands, to approach the cradle of her sleeping infant. Then, before the horror-stricken nurse could in any way interfere, she dashed the heavy fragment with all conceivable violence to the ground. Naturally the child woke startled out of its slumbers, opened its eyes, agitated its limbs, and began screaming lustily. Whereupon the mother manifested the most unmistakable signs of joy, thus revealing to the astonished nurse that this strange conduct had not been dictated by any homicidal tendency, but had simply sprung from the deliberate and maternal desire to ascertain if her child participated in its mother's misfortune.

Now, we only repeat this story in order to make one little comment on it.

Had it been possible for the mother to try her ingenious experiment at an earlier period of her child's life—say some three hours after birth—she would have suffered a grievous disappointment. The child would not have been aroused by the sound of the falling coal for the simple reason that it would not have heard it. The fact is, children are born perfectly deaf, and remain so for a space varying from six hours to two and even three days. That this should be so cannot be wondered at, when we remember that the human being comes into the world with an immatured nervous system, so that for some time after birth, certain of the sense organs are not ready to enter upon their normal activities. It follows as a necessary corollary from this, that the consciousness of the infant of a few days is something very different from that of a child of three or four years old. The infant's organic sensibility—all those sensations connected with the body's performance of its organic functions—is, with certain exceptions, pretty much in the beginning what it will be all through life. The sensation of hunger, for instance, is felt shortly after birth; and undoubtedly the pains of deranged digestion, resulting in infantile colics, are at a very early period a strongly marked and highly unpleasant experience for the infant. Again, susceptibility to temperature is a well manifested phenomenon. The intensity of the painful sensation of cold is attested by the cries, both of infants and other young animals whose temperature has been allowed to fall, while the pleasurable sensation induced by warmth is proved, at first negatively by the cessation of cries and all other signs of discomfort, and later on by the presence of those signs characteristic of general well-being. The sensation of warmth, indeed, is so grateful to the child, that it always argues either some constitutional peculiarity on its part, or some bad management on the part of those who have the care of it, if it fails to find pleasure from its immersion in warm water.

But this by the way.

So far as the foregoing and other of the organic sensations are concerned, the infant of a week old is very nearly

on a par with the child of a couple of years. The case is the same with regard to that one of the five senses which is most closely allied to organic sensibility. We allude to *Taste*.

Taste is a remarkably well-developed sense. The new-born infant is able from the very first to discriminate all strong impressions of taste, and, according to experiments conducted many years ago by Dr. Kussmanl, the expression of face for a bitter taste differs from the grimace elicited by a sour one, and both these, of course, from the pleasurable look which accompanies sweet tastes. Even in the absence of actual experiment the developed state of the sense of taste cannot fail to strike those who have had much to do with babies. The son of the philosopher Tiedemann, for instance, was observed by his father to distinguish the taste of medicine from that of his ordinary food when only thirteen days old. Professor Luigi Ferri, in an interesting article contributed to a scientific review ("La Filosofia delle Scuole Italiane") states that at a very early stage of his little girl's existence she obstinately refused goats' and asses' milk, while there are innumerable instances where infants of two and three months old have pushed away their feeding bottles when the contents were not sweetened to their liking.

In face of all these facts, we cannot but agree with Professor Preyer, that taste is the first sense, and judgment and memory have their earliest development in the region of this sense. It is partly on account of this that the purely instinctive action of taking nourishment so soon becomes amenable to the control of the will, till children not only sustain the necessary action when begun, but learn to make spontaneous movements to begin it.

After taste, the two senses which come earliest into play are smell and touch. Now, with regard to smell, it is more by logical deduction than by direct testimony that we can attest its presence. To the human being, smell is the least important of all the five senses, and therefore what olfactory sensations there are at the beginning of life would probably be of the faintest. We know, however, that the sense of smell cannot be in total abeyance, because it is intimately connected with taste, so that the presence of the one implies the presence of the other. Not to smell is not to taste—a truth recognised in the homely advice to "hold your nose" when you have to swallow nauseous medicine

There being no satisfactory means of discovering the relative intensity of the olfactory sensations of the new-born infant, some scientific inquirers have had recourse to experiments on newly-born animals. But such experiments are necessarily inconclusive as regards human beings, just because the place of smell in the hierarchy of sense is not identical in the case of men and animals. With animals, smell is the most important of the senses, since it is by its means that they track their prey and avoid danger. We are therefore prepared to find in them an early and wonderful power of discriminating smells, and the following experiment tried many hundred years ago by Galen makes no undue claims on our credulity.

Galen brought a newly-dropped kid into a room in which were placed several open vessels containing wine, honey, oil, grain, and milk.

Soon, the little animal struggled to its legs, and after staggering from one vessel to another, sniffing at each in turn, finally came back to the one which held milk and drank out of that. Obviously only the sense of smell could have dictated this choice, and a very finely developed sense too it must have been. In men, such an early development of this sense is not to be expected. As we said before, smell serves the very humblest functions in our lives, save, indeed, when there is any unusual want of acuteness in the other sense. Under these circumstances, truly smell rises into prominence and conveys to the mind much knowledge of outside things, which ordinarily would be transmitted by other channels.

As an example of this we may instance James Mitchell, the blind, deaf-mute, whose sense of smell was rendered so abnormally active by the defectiveness of his other senses that he could perceive the presence of a stranger simply by this one sense.

Rare and exceptional cases such as these, however, do not affect the general truth, that smell with us is a subsidiary sense, and therefore but feebly manifested in the infant's early life. When smell, however, does begin to show itself, it may be safely said that it will always be in the direction of what we may call alimentary odours. A child who, at the age of nine or ten months, shows a marked preference for chocolate, coffee, and all other articles of food which furnish sensations both of taste and smell, will be found on subsequent investigation to be very susceptible to smells generally. A. M. H. B.

(To be continued.)

THE FIRST INVENTOR OF THE TELEPHONE.—An important decision has been made by the American Patent Office examiner on the title to the first invention of the speaking telephone. The chief claimants for the honour were Bell, Edison, Gray, and Dolbear, but many other inventors set up claims to a share in the invention. The whole invention or subject-matter in dispute was divided under a number of heads. The first of these relates to the art of transmitting sonorous vibrations of all kinds and quality by varying the strength of an electric current, and Bell is declared the first to have invented this. In the second article, which relates to the means of transmitting speech by varying resistance in the transmitter, Gray was declared the first to conceive and disclose the invention in his caveat of February 14, 1876, but failed to take action and complete it until others had done so, hence the priority is awarded to Bell. Edison is declared the first to employ an "electro-hydro-telephone, the fluid holding vertically an adjustable tube, within which the ends of the platinum points are immersed," he having exhibited this feature in a water telephone at the end of December, 1876. Bell is awarded priority for the magneto-induction, transmitting, and receiving telephone; the date of his patent being February 14, 1876. An important decision relates to "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality. May, 1875, is the date of McDonough's invention of this device, and priority is awarded to him. The well-known Bell receiver is therefore a mere variation of McDonough's earlier invention; but the "combination with an electro-magnet of an iron or steel diaphragm secured to a resonant case" is declared to be Bell's. Edison is awarded priority in the case of a spring carrying one electrode and pressing it against the other electrode and diaphragm. While upon this subject, we may refer to Professor Silvanus P. Thompson's recent researches into the earlier works of Philip Reis, recently published in the form of a biography. Prof. Thompson shows that Reis is the original inventor of the speaking telephone, that he intended it to speak, and that it did speak more or less perfectly.—*Engineering*.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

Most of the older naturalists regarded species as originating in distinct creative acts, and the natural theologians following, or helping to mislead them, studied every creature and every part of each creature upon the supposition of special design and adaptation to the performance of particular functions. According to such theories the whole order of nature appeared as an exhibition of an infinite number of detached parts, and every organ of any living thing as a contrivance like a tool made by a skilful artisan. A stricter and wider examination of plants and animals showed points of connection and lines of transition. Descent does not invariably produce an exact repetition of the parent forms, but sometimes modifications occur, which, if useful to the creature, and also capable of hereditary transmission, give rise to varieties and species, the latter being, in fact, only the former in a lasting condition. Under the older conception, it was impossible to explain the existence of obsolete parts no longer useful, or of parts that did not work in the best possible way. The newer and truer philosophy discovers a unity of plan throughout Nature, and traces organs from rudimentary beginnings to their completest development. Eyes, for example, do not always see, as we understand seeing. The simplest eye forms no image, but allows its possessor to have some sensation of light; and organs of all kinds, which some creatures possess in an elaborate condition of structure, may be found in simpler stages of development in others. Another important fact brought into view by recent investigations is that parts which are morphologically the same may have widely different functions to perform. It is well to bear these things in mind when examining any of the interesting insects of the group to which bees, wasps, ants, &c., belong, and a caution may again be given to the effect that the more scientific view of Nature does not militate against Natural Theology, but, on the contrary, raises its character and strengthens its evidence.

The two orders Nemoptera and Hymenoptera are both composed of four-winged insects, but while the former—which are the best flyers—have equal wings, the latter have the hind wings much smaller than the front ones. The veins are also fewer, and do not produce the network appearance characteristic of the Nemoptera. The Hymenoptera have horny jaws, and tongues adapted to lapping, or both lapping and sucking, as in bees, and their maxillæ close upon the tongues and form a sheath assisting their action, as was explained in former papers. The females of different kinds of Hymenoptera are furnished with stings, saws, and ovipositors, very various in size and shape, but in all cases essentially the same organs modified to different uses. The wasps and bees deposit their eggs in cells which they build or dig out. Their stings assist in directing the eggs to the right place, but their chief function is warlike. They are weapons rather than ovipositors. The gall-flys' instruments are borers as well as ovipositors. They pierce little holes in trees, and, like the bees and wasps, eject an irritating fluid which stimulates the plant to develop the peculiar growth such as the nutgall, leaf galls, and spangles of the oak, or the hairy bedeguar of the rose, which serve at once as houses and larders for their grubs. The saw-flies have their terminal organs modified into saws, as their name suggests, with which they cut slits in bark or leaf, and drop their eggs into them. The ichneumons work with slender tools, longer or shorter according to their habits. They commonly insert their eggs into the bodies of aterpillars, and their grubs feed upon their host so prudently that they do not kill it until they are ready to emerge. A general description of the ovipositors, stings, &c., is given as follows, by Mr. Westwood. He remarks that "from the centre of the underside of the abdomen, near its extremity, arise two plates, each consisting of two joints, sometimes valvular, and together forming a scabbard, sometimes more slender, and resembling palpi, and sometimes very long; between these plates as they exist in the bee, under the form of two flattened plates with a pair of terminal lobes, arise two other pieces, which are very slender, serrated on the tip in the bees, but much broader in the sawflies, and transversely striated, forming the saws with which these insects are provided." There are five or six parts in these tools, though some are so often reduced in size as scarcely to be noticeable. In bees and wasps the sheath is a strong piercing implement, and it holds in a groove two fine stings which are worked by a mechanism that squeezes the poison-bag at the time they penetrate the victim of the attack. The serrated tips prevent their withdrawal out of any firm substance, and consequently when the insect strikes an enemy, it often inflicts a fatal injury upon itself. The sting remains, and the creature's inside is terribly torn as it drags itself away, and it soon perishes. If the sting were a separate and independent construction, designed entirely as a weapon, it might be compared with some of the cheap guns sent by Birmingham to Africa, which cannot be let off without injuring the shooter; but when its parts are found to be modifications of a set of organs belonging to large groups of insects, and subserving a variety of purposes, we can admire them for what they will do, and think less of their defects.

The Queen Bee has a sting curved like an Eastern dagger, and uses it in a murderous duel with any rival of her own sex, and the victor, if escaping whole from the fight, has nothing more to do with war's alarms, and if she does not turn her spears into pruning hooks, employs them in the peaceful purpose of assisting in the deposition of the many thousands of eggs she has to lay.

The variations of structure and function which the anatomist and physiologist trace in plants and animals proceed according to laws very imperfectly understood. Important modifications are concurrent, and mutually adaptive. In the Hymenoptera the mouth organs and the abdominal ones are suited to each other, and their internal organisation corresponds. Bees and ants stand highest in intelligence amongst insects. The order they belong to is a very large one. In this country it is reckoned that we have 3,000 species. Amongst so many there is room for a great variety of modifications, and it is very interesting to trace them in their mouths, legs, abdominal instruments, and nervous development. Insect phrenology is a very difficult study, but small as the brain is in the ant and the bee, it suffices for manifestations of intelligence as well as blind instinct, which leads Sir J. Lubbock to say that the chimpanzee and the gorilla must give way to them. All these creatures have to take care of their posterity. The bees store the honey that is to feed their young. "In the case of wasps, the larva requires animal food, and the mother therefore places a certain number of insects in the cell, each species having its own special prey. *Cerceris buprestida*, as its name denotes, attacks beetles belonging to the genus *Buprestis*. Now if the Cerceris were to kill the beetle before placing it in its cell, it would decay, and the young larva when hatched would find only a mass of corruption. On the other hand, if the beetle were buried

uninjured, in its struggles to escape, it would be almost certain to destroy the egg. The wasp has, however, the instinct of stinging its prey in the centre of the nervous system, thus depriving it of motion, and, let us hope, of suffering, but not of life; consequently, when the young larva leaves the egg, it finds ready a sufficient store of wholesome food."*

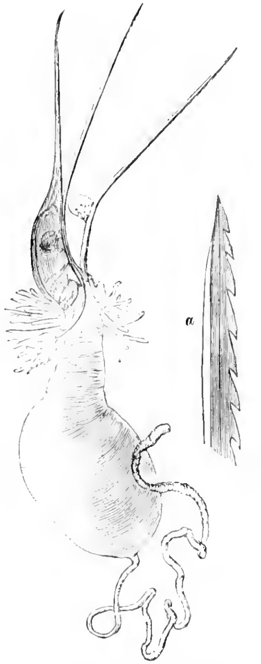


Fig. 1.—Sting of bee; *a*, Tip of lancet, more enlarged. Mr. Gosse exhibits a rounded projection, usually overlooked, which serves to guide the sting in the broader part of the sheath.

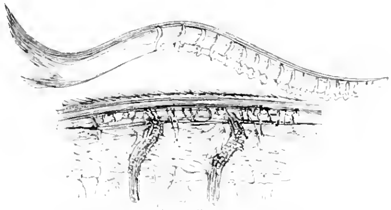


Fig. 2.—Outer saw of saw-fly; *a*, a portion more enlarged.

The drawing, Fig. 1, is copied from Gosse's admirable "Evenings at the Microscope," by far the best book of its kind. It represents the various parts of the bee-sting, together with the poison-bag. The tip of the sting is much like a saw, and this form, on a much larger scale, appears in the saw-fly, as shown in Fig. 2, also taken from Gosse. Besides an outer pair of these tools, the insect has an inner and finer pair, and each tooth is itself serrated. It would require a volume to explain the variations in the abdominal tools of the Hymenoptera. All require what in man would be called skill to work, and it is perfectly wonderful to find these creatures in possession of such apparatus, and of the central organisation which guides it to its proper use.

* Sir J. Lubbock's "Origin of Insects."

Agnosticism is of the essence of science, whether ancient or modern. It simply means that a man shall not say he knows or believes that which he has no scientific ground for professing to know or believe. Consequently (Dr. Huxley goes on), Agnosticism puts aside not only the greater part of popular theology, but also the greater part of popular anti-theology. On the whole the "bosh" of heterodoxy is more offensive to me than that of orthodoxy, because heterodoxy professes to be guided by reason and science, and orthodoxy does not.—*Professor Huxley.*

"Heath's Fern Portfolio" is the general title of a series of life-size reproductions of ferns, in which the author of "The Fern World" will give what has never before been attempted, namely, absolute *facsimiles* in form, colour, and variation, of those beautiful plants, together with letterpress descriptions on the same plates. Mr. Heath's new serial will be published monthly by Messrs. Sampson Low, Marston, & Co.

Scientific Hallucinations and Emotional Truths.—Do the strictest reasoners form a body of men hitherto free from false conclusions and illusory speculations? The driest argument has its hallucinations, too hastily concluding that its net will now at last be large enough to hold the universe. Men may dream in demonstrations, and cut out an illusory world in the shape of axioms, definitions, and propositions, with a final exclusion of fact signed Q. E. D. No formulas for thinking will save us mortals from mistake in our imperfect apprehension of the matter to be thought about, and since the unemotional intellect may carry us into a mathematical dreamland where nothing is but what is not, perhaps an emotional intellect may have absorbed into its passionate vision of possibilities some truth of what will be—the more comprehensive massive life-feeding theory with new material, as the sensibility of the artist seizes combinations which science explains and justifies.—*George Eliot.*

Bedford College, London.—This College has again this year sent up a very large proportion of the successful women candidates to the examinations of the London University for B.A. and B.Sc., the results of which have just been published. Of the twenty women who have taken the B.A. degree this year, nineteen have been placed in the first division, and of these nineteen as many as eight are from Bedford College, London, while the remaining eleven come from University College, London, Cheltenham College, Bowdon, Edinburgh, and some are prepared by private tuition. Nine candidates went up from Bedford College, London, therefore all have passed except one, and all are in the First Class, the College course having been found sufficient to prepare them for the examination. Only four women have been placed in the class-list of the B.Sc. degree—one from University College in the First Division and three others in the Second Division. Of these three, one is from Bedford College, London, and the other two have prepared by private study. Thus out of the twenty-four successful women in these examinations, Bedford College, London, can claim to have prepared more than one-third of the whole number.

Editorial Gossip.

I FIND that some even after careful study find the puzzle about American trains between New York and San Francisco perplexing. It may be thus dealt with. Suppose the journey to last exactly seven days, and the startings from New York and San Francisco to be simul-

S.F. . . . . . . N.Y.
A *b* *c* *d* *e* *f* *g* H

taneous. Then if A represents San Francisco and H New York, the distance A H contains seven days' journey, A *b*, *b c*, *c d*, &c. Now when a train is starting from A one is also starting from H for A, another is a day's journey from H at *g*, another at *f*, another at *e*, at *d*, at *c*, and at *b*. These seven trains are of course all passed by the San Francisco train on its way to New York; but during the seven days (exactly) that this journey lasts, seven more trains start from H, the seventh starting just as the San Francisco train reaches H. This last is not *passed* by the S.F. train, any more than was the train from New York which reached A just as our S.F. train was starting. But the other six must all be passed before the S.F. train reaches New York. Hence the total number passed is 7 + 6 or 13. If the S.F. train starts a few minutes or hours before a train reaches A, then it is easily seen that the total number passed is 14, one being passed at the beginning of the journey and all the first six from New York after the journey began. So also if the S.F. train starts from A a few minutes or hours after a train reaches A, still 14 trains are passed, for in this case seven are already on their way from New York, and seven more start before the S.F. train reaches New York. Consequently as the starting of the S.F. and N.Y. trains at the same precise moment is not the probable order of things, we may say that—save for this exceptional case—the right answer is 14.

Comparing the following account of the origin of the word Masher, by Mr. Howard Paul in *Society*, in which the true origin of the word is given with my own, it will be seen that my recollection was tolerably correct:—

The term "masher" originated in the green-room of the Union Square Theatre in the autumn of 1878. Two comedians attached to this popular establishment were extremely fine-looking men, Mr. M'Kee Rankin and Charles Thorne (both of whom, by the way, have played in London), and were immensely admired by the susceptible maidens of the great Empire City. These two gentlemen were the redoubtable heroes of *matinées*, and the ladies went so far in their *petits soins* as to send them *billets doux*, button-hole bouquets, and frequent anonymous *souvenirs*. Naturally there was some rivalry between the two actors, but they remained the closest friends. At a *matinée* where the audience consisted almost entirely of ladies, Thorn entered the green-room after a strong scene, and said, "Mac, I've done fearful slaughter to-day. Do you hear that applause? Listen to the gloved darlings." Rankin, who was in a gay mood, and enjoyed the highest animal spirits, replied, "Charley, I'm nowhere in this 'rig' (alluding to his costume), I only *touch* their hearts, but, by the gods, you *mash* 'em. "Ha, ha!" laughed Thorne, "mash is a good word." "Yes, my boy, you are the champion masher!" returned Rankin, and the actors in the green-room repeated the word admiringly. At the conclusion of the performance the two Lotharios, as was their wont, called in at the bar-room of the Union-square Hotel for a "tod," to use the local locution, and over their cocktails mentioned the phrase to a knot of journalists who were refreshing themselves. One of them, Mr. Chandos Fulton, made a note of it, and a week after, in the columns of the well-known theatrical paper, the *Sunday Mercury*, he wrote a sprightly article, "Heart Mashers at Matinées." The term "tickled the town," as Tony Lumpkin would say; the actors, the sporting fraternity, and men about town instantly adopted it, every well-dressed, smart young man was individually called a masher (much as we call well-got-up men here swells), and the phrase was brought to England by the actors who are incessantly crossing between the two countries.

The *Daily News* in a pleasant notice of my lectures dwelt more on the things running through them than I think desirable. The following remarks of mine on this point, and on the question whether declamatory arts are desirable in a lecture may be worth reproducing here:—

Your very kindly notice of my first lecture at Kensington is (in a sense) pervaded by an error which I am anxious to correct. Your reporter most have overlooked certain remarks which I made while the lights were being turned down and the lantern got ready for action. They were to the effect that the theory running through the lecture, the theory that worlds, like plants and like animals, have a life of their own, whose stages have certain characteristics which we may infer by reasoning and test by observation, was not what I wished my audience chiefly to consider; but rather the facts which were presented in association with that theory. "The theory," I said, "is but a thread on which I propose to string the pearls of known facts." Experience has shown that to state a series of facts, however interesting in themselves, is not sufficient to interest an audience who are not all experts in the subject—whatever it may be—to which those facts relate. The facts must be associated in some way by which the imagination may be interested and the memory assisted. In like manner, when dealing with the sun, I take a theory as to the origin and nature of sunspots which associates all known facts about them, and also about the coloured flames and the corona; but I am careful to point out that the value of the facts in no way depends on the strength of the thread of theory on which they are strung. In dealing with the moon I conceive a theory of successive stages of her vulcanian history, her existence as a probable abode of life, and her present condition; but the interest of the facts associated with this theory would remain if the theory should be disproved. I believe all three theories to be in the main correct, simply because they can thus be associated with all the facts at present known; but I by no means insist on their truth. I may remark here that there is some mistake about my "starting with Mr. Herbert Spencer's assumption that the world and the other planets of the solar system may be compared to 'cooling cinders.'" Last night was the first time that I ever referred, in my lecture on the "Life of Worlds," to that passing illustration in Mr. Spencer's masterly essay on the Nebular Hypothesis. I used it merely as a convenient illustration of the way in which large bodies retain their heat longer than small ones of the same kind.

One word more. There is a remark at the close of your report suggesting that declamatory arts only were required to make my lecture in a high degree impressive. During the fourteen years that have passed since I gave my first lecture, I have earnestly striven to rid my delivery of every trace of declamation. The great art of scientific lecturing, as compared with oratorical appeal, consists, I am convinced, in keeping the petty personality of the lecturer (necessarily petty in the presence of the great truths he is describing) from being obtruded, as it tends to be, between the audience and the subject of discourse. The arts of declamation all tend to bring the speaker's personality before the audience. And not only must they, in my opinion, be avoided, but, where they have been in any degree acquired, they must be carefully unlearned. If they rendered a lecture more pleasing the case would be different; for though the object of a lecture is to instruct rather than to impress, instruction is all the better for being made attractive. But my experience teaches me that an audience finds declamatory arts in scientific lecturing not pleasing but offensive.

THE FACE OF THE SKY.

From Nov. 23 to Dec. 7.

By F.R.A.S.

THE sun is getting low down in the sky, but should he examined on every clear day, within an hour or two of noon, for spots and faculæ. Maps XI. and XII. of "The Stars in their Seasons" may be consulted for the aspect of the night sky. Mercury is invisible, as is, in fact, Venus too; but Mars is nightly coming into a better position for the observer—in fact, by Dec. 7, he rises about 8h. 53m. p.m. He is in the blank part of the sky, west of Leo ("The Stars in their Seasons," Map III.). He still presents a very small disc, but it is large enough for the observer to see that it is "gibbons"—*i.e.*, not round, but like the moon when two or three days from the full. The Polar snow, and indications of dark markings, too, are beginning to be perceptible in a moderate telescope. Jupiter rises about 8h. 27m. this evening, and by Dec. 7

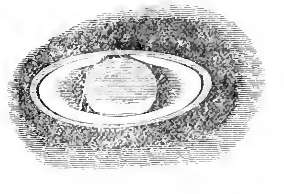
will rise an hour sooner. Hence, about midnight he is well up in the sky, in which he is now by far the most brilliant and conspicuous object. He remains in Cancer. The phenomena of his Satellites visible before 1 a.m. during the next fortnight are:—First, the egress of the shadow of Satellite I., to-night (23rd), at 10h. 38m.; followed by that of Satellite I. itself at 11h. 47m. Then, on Nov. 25, Satellite IV. will re-appear from occultation behind Jupiter at 12h. 38m. p.m. On the 26th, the shadow of Satellite III. will enter on to Jupiter's face at 10h. 40m. p.m. At 12h. 56m. 49s. on the 29th, Satellite I. will disappear in eclipse. On November 30, the ingress of the shadow of Satellite I. will happen at 10h. 12m. p.m., followed by that of the Satellite casting it at 11h. 16m. The shadow will pass off the disc of the planet at 12h. 32m., the Satellite not until the next morning. On the night of December 1, Satellite I. will reappear from occultation at 10h. 45m.; and Satellite II. disappear in eclipse at 11h. 32m. 27s. On December 3, the shadow of Satellite IV. will leave Jupiter's face at 10h. 6m., and forty-three minutes later Satellite II. will also pass off the planet's disc. Satellite III. will reappear from occultation at 11h. 58m. p.m. on the 7th, and six minutes after midnight the shadow of Satellite I. will begin its transit over Jupiter. Saturn is visible all night long, and is excellently placed for the observer. No more wonderful or interesting telescopic object than this planet exists in the heavens. Uranus is still invisible. Neptune is visible all night long with sufficient optical aid, and is travelling to the south of δ Arietis ("The Stars in their Seasons," Map XII). Pons's Comet, to which reference was made on p. 292, will during the next fortnight travel in an easterly and somewhat southerly direction, through that very blank region of the sky to the extreme north-west of the constellation Lyra. The moon is 23·5 days old to-day at noon; and, of course, 29·5 days at the same time on the 29th. Then at noon on the 30th she will be 0·7 days old, and 7·7 days old at mid-day on December 7. Hence she will scarcely be visible for the observer's purpose before December 3. No occultations of stars occur during the next fourteen days. At four o'clock this afternoon the Moon will leave Leo for Virgo; through which constellation she will continue to travel until 4 a.m. on November 27, when she passes into Libra. Her passage through Libra occupies until three o'clock in the morning of the 29th, at which time she enters the northern strip of Scorpio. She takes thirteen hours to cross this, and at 4 p.m. of the same day emerges in the southern part of Ophiuchus. Here she continues until 5 a.m. on December 1, when she crosses into Sagittarius. She does not quit Sagittarius for the northern part of Capricornus until midnight on December 3, and at five o'clock the next afternoon travels into Aquarius. Here she remains until 10 a.m. on December 7, when she enters Pisces. We there leave her.

SATURN IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

INASMUCH as it has been represented to us that our notices on pp. 313, 221, and 220 respectively of Vol. I. of the planets Mars, Jupiter, and Saturn, as seen : 3 inch telescope, were of too curt and merely incidental a character, and that somewhat fuller information is needed as to the aspect of these planets in such an instrument as that whose use we are presupposing; we now purpose to enter, in three separate papers, rather more into detail of the phenomena which they present in a 3-inch telescope, and to give the necessary information concerning all that the student may reasonably expect to see of them with it.

Coming as Saturn does into opposition to the sun during the early morning of November 29th, with his rings nearly at their greatest opening, and southing in this country at an altitude of between 50° and 60°, the planet could hardly be in a more favourable position for the observer than he is at present. He will be found in the sky just now to the north and west of Aldebaran ("The Stars in their Seasons," Map I.), and will be instantly identified by the leaden hue of his light as contrasted with the red colour of "The Bull's Eye." The subjoined sketch of the planet was made at the telescope with a power of 204 on the night of November 13th, at 11h. 45m. p.m.

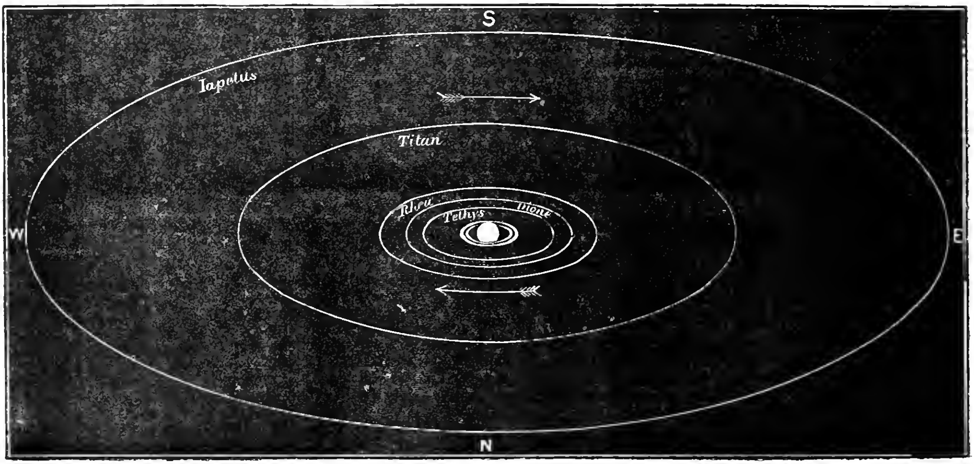


Saturn, 1883, Nov. 13, 11h. 45m. G.M.T., power 204.

The flattened figure of the planet will at once strike the observer's eye. In other words, he will note that instead of presenting a circular disc, the outline of Saturn is very perceptibly elliptical—or, as it is commonly called, "oval"—the longest diameter of the ellipse being in the direction of his equator. Technically, his figure would be described as an oblate spheroid, which, put into plain English, means that instead of the planet being a perfect sphere, he is, as it were, turnip-shaped, *i.e.*, flattened at the poles and bulged out at the equator. This effect of the rapid rotation of Saturn needs no further mention here. The southern part of the globe (that which is uppermost in the telescope) will be seen to be covered by a perceptible dark shading, which, however, terminates with a well-defined edge not far from the planet's equator. Below (north) of this is a bright equatorial band. The general yellow tint of the ball is also a notable feature. Where the ring crosses Saturn's disc a broad line of shading will be observed, and a careful and attentive study of this under good definition will show that it consists of two parts, a dark, broad line of shading crossing, as we have said, the face of the planet; and seemingly superposed upon it, and in contact with the inner edge of the ring, a very narrow *black* line. This latter is the real shadow of the ring upon the planet. The broader stripe is a part of the strange interior dusky or "crape" ring, of which we are to speak immediately. If we turn now to the ring itself, we shall perceive that it really consists of two concentric ones, the inner one being very much broader, and notably brighter than the outer one, or than the dusky capping on the southern hemisphere of the planet. A narrow dark line will be seen to separate the inner ring from the outer one. In telescopes of 4 inches of aperture and upwards this dark division is traceable right round the ring. With a 3 inch telescope it will, under favourable circumstances, be well seen in the "Ansæ" (the eastern and western portions of the ring), but will scarcely be fairly discernible entirely round. At moments of the best definition the shadow of Saturn will be seen, as drawn above, projected on the inner ring only, the black line, known from its discoverer as "Cassini's Division," at once bounding it and the planet's south pole on the south. The "crape" ring to which reference has previously been made is just beyond the power of our instrument. On nights when atmospheric conditions admit, however, of the use of a high power, faint indications of it may be seen in the form of a seeming ill-defined shading away of the inner edge of the broad interior ring, in the Ansæ. No connection, though, is traceable between this and that portion of the dark ring which is seen crossing Saturn's disc; albeit in larger instruments the whole

elliptical outline is seen to be continuous—save, of course, where the planet itself is superposed on it. The rings are known to astronomers as A, B, and C; A being the outer ring, separated from B, the broad bright inner one, by Cassini's division, and C, the innermost crape ring, which we have just been describing. Ring A itself has been seen to be further cut into two by a division known as Encke's; but assuredly this has never been effected with a 3-inch telescope.

Saturn, as may be learned from every primer of astronomy, is attended by eight satellites, of which three are wholly invisible save in large and powerful telescopes. We find, however, that in speaking of those named Tethys, Dione, and Rhea, on p. 221 of the first volume of KNOWLEDGE, as "too severe tests for a 3-inch object-glass," we were really doing an instrument of that size an injustice. By hiding Saturn behind a very thick wire in the eye-piece, or by any cognate contrivance, Tethys and Dione may sometimes be glimpsed on a dark night. Rhea was even visible in the bright moonlight while the sketch of the planet given on the previous page was being made, and we fancied (although it may have been only fancy) that Tethys sometimes flickered up for a few consecutive seconds at distant intervals. Inasmuch then as, under sufficiently favourable circumstances, the possessor of a first-class 3-inch telescope may hope to perceive four, or even five, out of the eight satellites by which Saturn is attended, we here give a drawing to scale of their orbits, by the aid of which the student may recognise them.



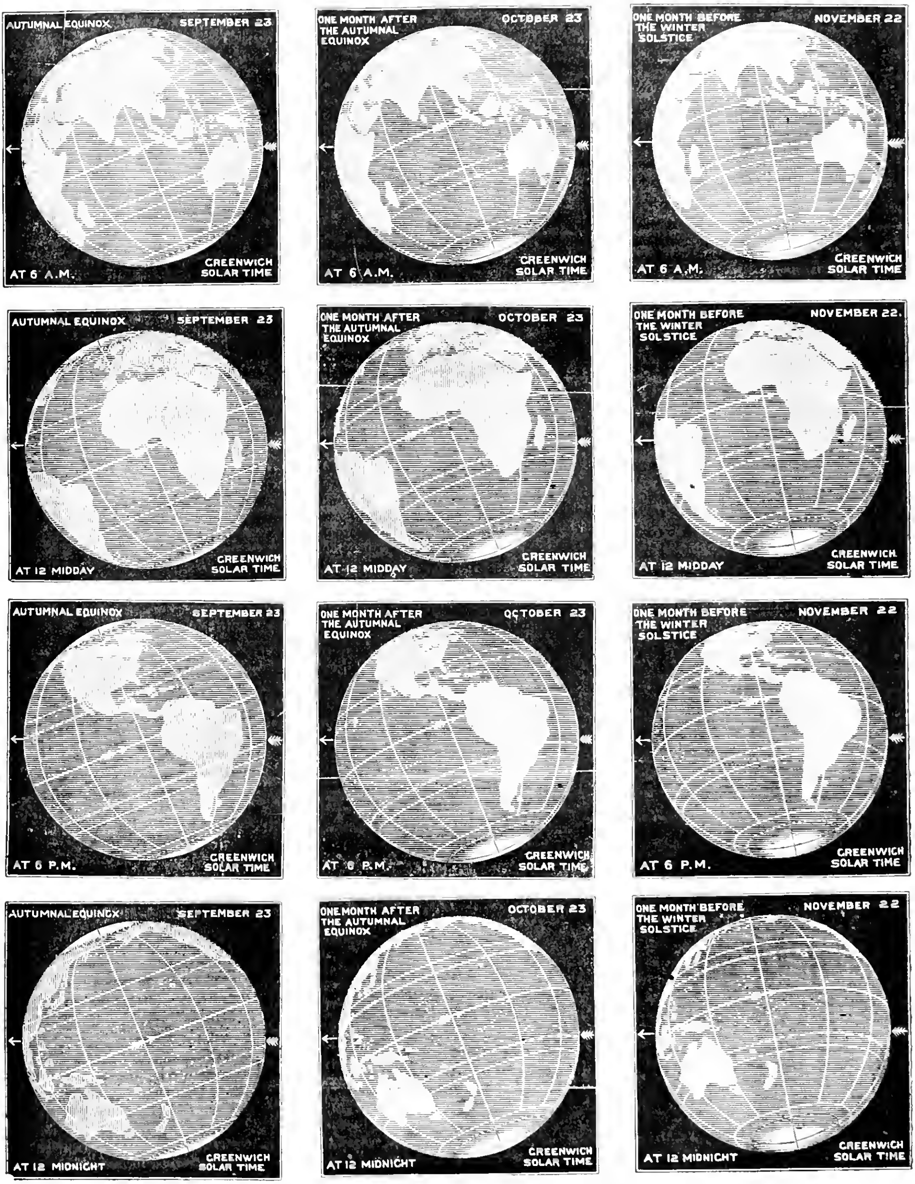
The arrows show the direction of their motion, in connection with which it may be noted that, at first sight, this motion may seem to be *retrograde*. It must, however, be borne in mind that we are looking at Saturn's south pole, and, so to speak, viewing the orbits of his moons from underneath. In 1899, when the north pole of the planet will be presented to us practically as the south pole is at present, the satellites will be seen to be travelling in the same direction as those of Jupiter, or as our own Moon, &c. Tethys and Dione must always be difficult objects in a small instrument, and require, as we have said, the planet to be hidden, and a moonless sky, to be even glimpsed in a 3-inch telescope. Rhea is a little easier, but will be best seen when at its greatest east or west elongation. Titan shining as a small eighth magnitude star is practically always visible. It occasionally transmits the disc of Saturn, and under these circumstances its shadow has even been seen as a tiny black dot, crossing the face of the planet, with only $2\frac{7}{8}$ in. of aperture. The light of Iapetus is (from some cause at present imperfectly understood) variable. This satellite is very markedly brighter when at its western elongation.

Such are the most salient features of this wonderful planet, as seen in a small telescope. We can only express a hope that our description of them may set the student seriously to work examining them for himself, with the best instrumental means he can obtain. The interest which the contemplation of so wonderful and beautiful an object must perforce excite, will, almost of necessity, induce a desire for fuller information concerning it. For such information, of a practically exhaustive character, no better or more interesting a work could possibly be found than "Saturn and its System,"* by the Editor of this journal, which has been described, with perhaps as little flattery as ever appeared in a critique, as "one of the most masterly monographs on an astronomical subject in the English language."

THE *Railway Review* (Chicago, Sept. 15) devotes considerable space to the discussion of the question of standard time, now occupying much attention in America. It reprints a letter published in the *Railway World*, urging the adoption of noon by Greenwich time as the universal railway standard, and counting from it all round the clock, the twenty-four hours being each simultaneous all over the continent. The suggestion which it advocates, however, is the less sweeping one of Mr. W. F. Allen, secretary of the time conventions, who proposes that North America should be divided into five sections, as follows:—First, the intercolonial, with a central meridian 60 deg. west of Greenwich; second, the eastern; third, the central; fourth, the mountain; fifth, the Pacific division, the central meridian of each being 15 deg. from that of the next, and the difference of time throughout each being precisely one hour.

* London: Chatto & Windus.

At the Autumnal Equinox. | One Month after Autumnal Equinox. | One Month before Winter Solstice.



SUN VIEWS OF THE EARTH;
OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week the Sun Views for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight, Greenwich solar time, a month before the winter solstice. For comparison, the Sun Views for September and October are repeated.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

STRANGE SEA CREATURES.

[1016]—In your article on "Strange Sea Creatures," you have doubtless been led to suggest that I was deceived as to the creature which I am convinced was seen by my friend and myself at Bude about three weeks ago, by the very short statement which I sent to the *Times*. Since I sent that notice further information has reached me, which may possibly induce you to modify the view that it was an inanimate object which passed us. The distance from Bude to New Quay is by sea very nearly 40 miles. The creature, which passed us about 4.20 p.m., was seen passing New Quay at 5.30 p.m. the same day. It is scarcely possible that there can have been *two* uncommon marine monsters on this coast about the same time. If it is the case, then, that the *same* creature was seen in one part of the sea at 4.20 p.m., and in another, 40 miles off in an hour and ten minutes after, it is pretty certain that the appearance was not that of an inanimate mass of sea wreck. The rate of movement was much faster than any sea-current on this coast would carry an object. It was seen by several persons at Bude. Some men at work first saw the creature approaching New Quay, and compared its progress through the water to that of a huge rat. Three ladies watched it from the next headland beyond New Quay, a height of 80 or 90 feet above the sea, and distinctly saw its head, which they said was like that of a huge conger or snake. They state that it was about 50 feet long, that it left what seemed to be a greasy trail in its wake, which was visible for a quarter of an hour after it was lost to sight, and by which they could trace its course. It was seen also by persons about two miles north of Bude, coming down towards the land from the open sea, north-west of us. My first impression of it was that it was a long boat, which had got adrift from some ship, but the unusual length surprised me. Then I soon saw that no boat or large log of wood could be moving at such a rate. Having no telescope at hand, or within reach, during the short time the creature was in sight, we could make out nothing distinct as to the shape of the creature. It went through the water apparently without much exertion, for we saw no commotion in the water as it went along. It was in sight the *whole* time, till it was lost in the distance.

I should like to know whether a calamary would travel at the rate of this creature, and with the same regularity. I am told that a whale would go beneath the surface, and not proceed in the same steady course as this creature did. It was my own impression at the time, and has been ever since, that its movement most resembled that of a huge rat swimming very swiftly through the water; and I was glad to find that it coincided exactly with that of the men at work at New Quay.

I quite agree with your conclusion that there are many species of marine animals of which we know little, or even nothing at all; and I shall be glad if this plain statement of what was seen here induces the sceptical to believe this. Fragmentary observations, when properly pieced together, may increase our knowledge of the wonders of the deep. E. Highton.

Bude Vicarage, *Nov.* 3, 1883.

P.S.—Admiral Jones' experience is not much to the purpose.—E. H.

[I am much obliged to Mr. Highton for his very interesting communication. I intended to suggest rather the possibility than the probability that one of those singular illusions produced by the movement of masses of matter like seaweed in a disturbed sea may have accounted for the sea monster he seemed to see. I am myself one of those who regard the rejection of all such accounts in that way as altogether unscientific.—R. P.]

A MOONLIGHT ASCENT IN A BALLOON.

[1017]—The distorted appearance of the earth's surface as seen from a balloon during sunlight, is not the same as that seen from a balloon during moonlight. In the latter case it has more the form of a spherical or convex than that of a saucer-like or concave aspect. Describing his moonlight ascent from the Crystal Palace in August, 1866, when eight persons accompanied him, Mr. Coxwell says:—"But what impressed me as worthy of more particular attention, and I have frequently observed it before, was the great contrast between the view of the earth by day and that by night. By daylight the surface of England has that beautiful bowl-shaped and variegated appearance, with every conceivable hue and form, which no picture, and only a widespread landscape can possibly offer to notice. By moonlight you are able to observe for a circle of a few miles around you the hedgerows, trees, woods, and water, and even to detect shades of difference in the colour of the fields; but away towards the horizon, where it is dark and yet visible, you observe more the planetary and material form; and if by any unseen and invisible means one could be suspended at tolerable altitude, the idea would certainly be uppermost that an approach was being made to the confines of some vast globe, where immediately beneath you there were signs of busy life and cultivated soil. The general contour of the earth strikes one as coming nearer by night to what imagination pictures of a world in space; it assumes a less concave, if not a convex form, and the subdued light of night shades over and above the black horizon strongly define the boundary of the terrestrial matter from space." J. Dyer.

PERFORATED STONES IN INDIA.

[1018]—Perhaps some of your readers or correspondents may be able to give me information as to the exact localities in India where perforated stones exist through which persons pass, and are thought thereby to attain a higher life or to become new-born in the same sense that the rulers of Travancore, being of the Nair caste, become Brahmins by passing through a golden cow or lotus. I believe one such stone exists near Bombay, and another in Guzerat. Any details regarding the use and actual position of either of these stones, or of any others of the same nature, will greatly oblige.

Cosmopolitan.

STRANGE PHENOMENON.

[1019]—The following extract from a private letter, dated Kurrachee, Oct. 11, seems somewhat remarkable, following on your correspondent's mention of the green sky which has caused so much perplexity of late in India:—

"The weather is getting pleasant now, and every evening after sunset we have a most extraordinary brilliant glow in the sky. As it is over Mecca, the Mussulmans think it portends the arrival of the Messiah, or some other terrific event."

Nov. 15. Major ab Adversis.

ANTHROPOMETRY.

[1020]—Though not possessing any scientific knowledge of ethnology, yet emboldened by Mr. Grant Allen's expressed desire for information about the peasant-farmers of my native county, I gladly offer the small mite of my personal experience for the benefit of that gentleman, whose charming papers in Knowledge have been the source of much pleasure to me.

Six or seven miles from the capital of North Tipperary, in the valley surrounding the hamlet of Templederry, there used to be in my childhood one of the finest race of men I have ever seen. Judging from their surnames alone, the inhabitants of this valley must have been of mixed blood, partly English and Welsh, as well as Irish, for while there were O'Bryans and O'Learys, there were also Vickers and Gilmartins among the Catholics, and Powells and Howells among the Protestants. It was a sight on a fair or market day, to see the well-clad well-fed, and well-mounted peasant-farmers of Templederry ride into the little assize town of Nenagh, with their bright-complexioned faces beaming with good humour and independence, and their short frieze capes flying in the air behind them. The mere sound of their merry voices and happy laughter seemed to impart vitality to the listener.

They were mostly over six feet, and were broad-shouldered, deep-chested, fair or florid complexioned men, and many of them had the unmistakably narrow English oval shape of face and head.

Protestants of this valley were generally styled Palatines by the Catholics, but I can't say whether they were aware that this title was derived from the English settlers of the Pale. The farmers of Templederry were specially favoured both by circumstances and surroundings. Their land was very fertile, there was abundance of good food, and the air from the neighbouring hills was at once balmy and invigorating, and imparted to those who breathed it a buoyant elasticity.

In the nearest town, I know at present three young men (brothers), who range from 6 ft. 2½ in. to 6 ft. 4 in. in height, and as the youngest (who is *not* the shortest) is only seventeen, I take it for granted that they may still grow taller.

Now these young men, who are very patriotic, would be incredulous, as well as indignant, if told that their name was an old Yorkshire one, and that their father had a decidedly English face.

My experience of the peasantry on the west coast of Ireland does not lead me to conclude with "Hallyards" that men living on the sea-board are larger and taller than those inland. On the coast of Clare, in the neighbourhood of Skilkee, or thereabouts, the peasantry struck me as of a totally different type from the same class of men in Tipperary. They were much smaller and slighter, had generally dark hair and eyes, and were mostly sallow or pale complexioned, and lacked altogether the bright fresh colouring of the Tipperary farmer. It is true that here and there one might come across a fine young fellow, with dark flashing eyes and wild romantic mien, but this was the exception and not the rule. On the other hand, the women of this district had the advantage over the men in both face and figure.

I have seen some very handsome peasant women in Clare. I have no recollection of hearing any English surnames in this part, nor did I notice anyone possessing the English type of features. Along the coast from Clare to Ballyvaughan and farther on, many of the fishermen seemed to me particularly undersized, rather of the squat broad Dutch make.

It cannot be altogether race which makes this difference, for, setting aside the question of peasantry, some of the old Irish families on the west coast have been noted for generations for their handsome faces and splendid figures, and among them to this day there are to be found men every whit as fine-looking as in Tipperary.

Sea air is a tonic which requires the addition of good food to draw out its properties, but sea air alone is of small avail to give height and strength to badly nourished, badly clad, and overworked bodies.

Mr. Grant Allen would find in "The Making of England," by the late Mr. Green, many interesting items about the English settlers in Ireland,—I am, Sir, yours sincerely. E. O'Shea Dillon.

Nov. 3, 1883.

[1021]—I never meant to dispute such an obvious fact as that one race is short, another tall. I only cherish a doubt as to whether it is a question of race or of habitat. Our American cousins are certainly often like Red Indians; yet there has been no intermarriage. The descendants of the English in Ireland are *ipsis Hibernis Hiberniores.* I have remarked that Australians born are less intelligent than members of the same race born at home. The character of the modern French—a very mixed race—is the same as that Cæsar gives of the pure Celts of Gaul in his day, "novis rebus studentes." Modern Greeks have most of the characteristics ascribed by Roman authors to the ancient Greeks, and yet it is asserted they are of Slavonic race.

Admitting that the Scottish Lowlands are of diverse origin, I still question whether the seaside men are of a race which does not also exist largely inland. In Normandy, England, Ireland, &c., we do not find conquering races sticking always at the coast. If Tipperary men are, as is said, Cromwellians, surely that is in favour of my contention; for there is no English militia regiment of Grenadiers over 6 ft. Hallyards.

GREEN SUN AND SOUND WAVES FROM KRAKATOA.

[1022]—In the early part of September there was great excitement here in consequence of the dimmed light, blue and green tinted, of the rising and setting sun, which was, indeed, very remarkable. Miss Pogson attributed it to the presence in our atmosphere of sulphurous vapours from the recent Krakatoa eruption, the distance of which from Ceylon is 2,000 miles. By a good many other people the great sun-spot then visible was blamed as the cause of the phenomenon. I send you a cutting from our local thunderer, which is not an illustrated paper, except in times of great excitement. I think it is a curiosity in its way! But my chief object in writing to you is to ask a question. Not only was our sea greatly agitated, but the volcanic explosions of Krakatoa were distinctly heard in all parts of our mountain zone, if not also in the surrounding low country. I heard them myself, exactly as though there was heavy gun-practice a few miles off, or dynamite rock-blasting a mile or so away, sharp and loud. What I wish to ask is: did these sound-waves travel through the air, or through the earth's surface-crust, causing the sounds to be heard here as through an ordinary telephone-receiver? I may mention that the green tint of the sunshine on white walls was still markedly visible, though faint, a few mornings ago at sunrise.

Ceylon, *October* 17th. R. Wade Jenkins.

[I should say that the sound-waves were conveyed through the earth's crust.—R. P.]

THE SEVERE WEATHER OF THE 13TH-15TH.

[1023]—I do not know whether any of your readers encountered such severe weather as we have had in this locality (S.W. of England). I give you the readings of my thermometers corrected at Kew to 0·1 deg., and exposed under the uniform conditions required by the Meteorological Society:—

Night of 12th ...	Minimum temperature on grass ...	22·2 deg.
,, 13th ...	,, ,, ...	22·3* ,,
,, ,, ...	Minimum temperature in "Stevenson" screen (4 ft. above ground) ...	20·8* ,,
Day of 14th ...	Maximum temperature in screen ...	36·7 ,,
Night of ,, ...	Minimum temperature in screen ...	22·8 ,,
,, ,, ...	,, ,, on grass ...	21·1 ,,

And most noteworthy of all was the temperature of the air (dry bulb in screen) at 9 a.m. on the 14th, viz., 23·1 degrees.

I am only a novice in meteorology, but this latter low temperature seems almost unprecedented for the season and locality. On referring to the Meteorological Society's Weather Report for the 14th at 8 a.m., I cannot find any shade temperature in the kingdom lower than 28 deg., viz., at Parsonstown, and only one foreign station (viz., Haparanda) where the temperature equalled that of this place.

I should add that the altitude of this station is 376 ft. above the sea, also that a dense fog prevailed during most of the day (14th). —I remain, sir, yours obediently, H. J. Poole, F.R. Met. Soc.

JUPITER WITHOUT SATELLITES, OCT. 15, 1883.

[1024]—A friend sends me extracts as follows from *English Mechanic*, Oct. 26, 1883, p. 169:—"Jupiter, it appears, was not seen without satellites as predicted for Oct. 15. Several correspondents send notes of observations of the 3rd Sat., which was visible on the E. limb at 3.56, and about the same time the 'fourth' made its appearance on the W. limb; so that the *times* given in the 'Nautical Almanack' must be wrong." And again, same publication, dated Nov. 2, letter 21,986:—"Oct. 15 I saw Jupiter without his satellites, but two were really visible all the time, hanging on, one to each limb, &c.—M.A."

May I ask whether you are aware of any others who can clear the question as to the visibility or otherwise of satellites of Jupiter on Oct. 15, 1883, 3.56 a.m. to 4.15 a.m.? Thos. Radmore.

[These discrepancies agree well with the evidence already obtained as to the variability of Jupiter's outline (his real surface being probably thousands of miles within it).—R. P.]

LETTERS RECEIVED AND SHORT ANSWERS.

J. A. L. Robson. Increase of earth far too small to affect her orbital motion. If her mass were doubled or trebled, her orbit would remain unchanged.—J. Whitsterby. You were certainly right in having an astronomical eye-piece added to your refracting telescope. To use it, remove the terrestrial eye-piece, and having inserted the astronomical one, direct the instrument carefully on any convenient object, as a house-roof, which will divide the field very obviously into two different tints. Then push the tube in and out till you see the outline of the object becoming sharp and clear. After that you can use the focussing rack-work. It will now be right for that distance. If turned on the moon or a star it will be found to be out of focus, but not so much but that a slight movement will set it right.—J. L. Flewett. Thanks.—E. P. Westlake. Regret that at present we have no available space for bee-culture. —W. Schweizer. In my "Myths and Marvels of Astronomy" Swedenborg's world dreams are spoken of.—M. St. Vincent. None of your three sketches in the slightest degree resemble the moon's path.—E. W. Ought I not rather to ask such questions of you with your longer and doubtless wider experience? Besides I should want a list of the books of that kind which you have already read.—E. Groth, M.D. Regret that the

* The difference marks the fog which existed at the time.

work is not known to me.—C. Davison. All those ideas about earthquake predictions based on mere coincidences,—about as trustworthy as the sun-spot influences on commercial crises and other such nonsense. Captain Delanney is a mere paradoxist.—T. Kinmer.—We do not undertake to work sums.—C. Stretton. Thirteen if the trains start simultaneously, otherwise fourteen. Thanks for date information, but the lines are known, and the reference to first table in Prayer-book rather complicates matters.—J. C. M. D. Letter forwarded.—A Lady Mathematician. . . . . "By-and-by, 'O strange!' says she, 'what a noise there is in my ears, as if ten thousand paper-mills were going.' A little after she was at it again, 'Look, look, what is that I see yonder? It is just like the flame of a fiery furnace.' To whom the dame replied, 'Prithee, child, if you would have us allow you any sense at all, do not affect to show more than Nature has given you.'" *Æsop.* You see two or more can play at the polite "nonsense!" game. In fact, three or four. For you and I are 2, and Messrs. Foster and Clodd are 2: but you may believe in Mill's cheerful universe where 2 and 2 may be 3 instead of 4. Quaternions belong to the common sense of mathematics, and the square root of a negative number is only inconceivable if you insist that the square root shall be a number of a certain kind, just as the length of a line at right angles to another may become inconceivable if you insist that that length shall be regarded as measured along the other. The square root of a positive number is utterly inconceivable *if* the number represents time, or shillings, or pecks of potatoes. But the ideas which you seem to think conceivable (though Cayley and Helmholtz knew better than to say *that*) are about as conceivable as time progressing sideways, or as squared time, or the cube root of ten degrees of heat. If you will give us an essay on the quadrature of a time-circle I will tell you just how you are mistaken as regards Messrs. Foster and Clodd.—Uncertain. Considering that the whole question is, *Where* are the limits? how shall we begin our inquiry by defining the limits? To use your illustration, it is as though France and Spain desired to determine their border line, and some one started at the outset the objection that the question could not possibly be dealt with till it had been settled what is France and what is Spain, which could not be done until the border line had been determined.—J. B. Finlay would be obliged if Mr. Grant Allen would name the printers and probable cost of Dr. Hull's Geological Charts.—X. Y. Z. You might as justly argue that the return motion of a point along a line gives a second dimension.—Thos. Padmore. Thanks. The points you note are interesting. They correspond to the fact, which has been shown by other observations, that the outline of Jupiter is variable.—C. Collingwood. Thanks, letters printed.—H. Chaplin. There seems to me no objection to the belief that downfalls of the kind would only happen occasionally, when the walls chanced to be unusually precipitous. Most mountain ranges would be free from danger. There may be much heat internally still, and almost certainly there is much water.—E. T. L. Calculate the effect; and "please find enclosed" in calculation the disproof of your earth-piloting theory. —A Poor Student. *Vide Nautical Almanac* for right ascensions of Ceres, Vesta, Juno, and Pallas, at any given date. Your "present time" is so vague. Periods. 1 (Ceres), 4·61 years; 2 (Pallas), 4·62 years; 3 (Juno), 4·36 years; 4 (Vesta), 3·63 years.—J. J. Scargill. Certainly not fiery rain, but whether showers of falling stars looking like rain, or some purely local phenomenon, information too vague to enable me to say.—A Constant Reader. Oh come! I say!—look here, now!—it's all very well to give me a formula, and to say h is so and so, d something else, and l such and such; but what does the "tottle of the whole" mean? *Is* it the discharge per second in gallons, or cubic feet, or what? Because if you will tell me what it is, I will tell you what you want to know. —W. Gibson. I cannot find the duplication of the cube in your enclosure. Are you clear as to what the problem *is*?—S. L. B. I quite agree with you that the use of imaginary quantities differs entirely from such questions as quadrimensional space, non-Euclidean geometry and so forth. But I fear the subject would hardly please the readers of Knowledge. It seems generally forgotten that when we apply algebraical treatment to geometrical problems, we are not free to assume that everything involved in our geometrical subject matter is necessarily expressed in our analytical formulæ, and that these formulæ necessarily express nothing more than is involved in the geometrical relations we use them to illustrate. Thus when we take the equations $x^2 + y^2 = r^2$ and $x = d$, to represent a circle with radius r, having the origin of co-ordinates (right angled) at its centre, and a straight line at distance d from one of the axes, we must remember that these equations do not in reality express these geometrical relations but only illustrate them. They are relations between matters measurable numerically, but not themselves numerical. In dealing with them we get other numerical relations, not all of which necessarily illustrate the geometrical relations we are dealing with. Thus if d is greater than r, so that we obtain for the value $x = d$, $y = \sqrt{r^2 - d^2}$ an imaginary value so far as the geometrical illustrations involved are concerned, we need not therefore imagine that we have found evidence about imaginary space. It is worthy of notice that even the square root of a positive quantity has no analogue in space relations, if the positive quantity represents a straight line. So with time. Our numbers may represent time past or present; but when we get to their squares, cubes, or square roots, they have no relation whatever to anything connected with time. The expressions a^2, a^3, $\sqrt{a}$, &c., are fully as imaginary as the expression $\sqrt{-a}$ if a represents a time-interval. Yet this does not prevent our dealing with a^2, a^3, $\sqrt{a}$ in problems relating to time, and getting correct and real solutions.—Frederick Thompson. I see no reason *why* your "pot of potatoes" should be scattered over the floor; so am at no pains to explain their quiescence. You think we rotundists want to immolate our opponents (save the mark!) as heretics. If you think that, you would think anything. I feel about as anxious to immolate the Flattists as I do to set fire to Earlswood Asylum. But wait at least till you have squared matters with Hampden and Parallax before you come rounding on me. You doubt whether there is any North Pole! Now, they respect it as the centre of everything. Why you will malign, next, the very meridians! But seriously what *can* you suppose it matters to me whether you understand or fail to understand the nature of the world you live on?—Hy. Lancaster, Ed. Radford. You choose the hardest worked person you can find to do what you could easily do yourself. Do you imagine I keep a list of all the advertisements which have appeared in Knowledge? It is not so, I assure you.—A. McCallum. Permit me to say that if I use Knowledge occasionally for my own purposes I pay for the privilege, and full value too. If I did not feel free to do so much as that, I should drop Knowledge rather quickly. The article on the Spencerian philosophy appeared in the last volume of my essays published by Messrs. Chatto & Windus.—L. S. M. P. *Quien Sabe?*

Our Whist Column.

By "Five of Clubs."

The question of the value of the signalling system at Whist has brought us many very interesting communications, from among which, with thanks to the rest, we select the following:—

CONVENTIONAL RULES AT WHIST.

Some months ago there was a very able discussion in the *Field* upon the policy of leading Ace originally, from Ace to four. There was, of course, the objection that such a lead simulated the lead of Ace, from Ace to five or more. On the other hand, some writers gave their experience that by leading a small card, from Ace to four, they had frequently not made a trick in the suit, the first trick having been won by the adversaries, and the Ace trumped upon the second round. I took no part in the discussion, but I may say, *en passant*, that I am in favour of leading a small card from Ace to four originally, and also in the course of the hand, unless, in the latter case, the play of the previous suits has shown an irregular division of the cards, in which event the Ace might be in danger. I am in favour of leading a small card as above because I am in favour of uniformity at Whist. I lay no stress whatever upon the argument that uniformity gives information to the adversaries as well as to the partner.

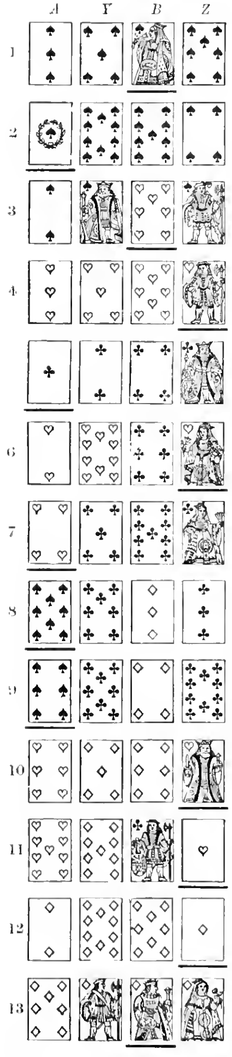
Success at Whist depends upon the faculty of combination and the rapidity and accuracy with which correct inferences can be drawn from the fall of the cards, and if information is to be withheld because the adversaries may make use of it for the purposes of their strategy the whole science of the game is gone. But there may be, and frequently is, what I call an *abuse* of uniformity; where, in order that his hand may be counted or his cards known, a player will under all conditions and without reference to the score play according to conventional rule. Good players will, however, frequently deviate from recognised play, and indulge in what I hope I may be permitted to call the common-sense of Whist.

To illustrate the last observation I send you a game in which I played *A*. It will be observed that I had Ace to five and did not lead the Ace, and that I had five trumps and did not lead one. Both conditions were combined in my hand, which might have induced one set of players to lead a trump notwithstanding the Knave turned, and another set to lead the Ace of the suit. In my judgment either play, although in the direction of uniformity, would

have been bad Whist—taking the score into consideration. I refer you to the notes upon the game. FREDERIC H. LEWIS.

THE HANDS.

Y.		B.
Hearts—10, 5.		*Hearts*—8, 7.
Spades—K, 10, 5.	Y B	Spades—Q, 9.
Diamonds—Kn,10,9,5.	Score— A B, 3. Y Z, 2.	Diamonds—K, 8, 6, 4, 3.
Clubs—8, 7, 5, 2.	Dealer.	Clubs—Kn, 9, 6, 4.
A.	A Z	**Z.**
Hearts—9, 6, 4, 3, 2.	*Trump* H.Kn.	*Hearts*—A, K, Q, Kn.
Spades—A, 8, 6, 3, 2.		Spades—Kn, 7, 4.
Diamonds—7, 2.		Diamonds—A, Q.
Clubs—A.		Clubs—K, Q, 10, 3.



MR. LEWIS'S NOTES.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. *A* treats the suit as if it were not headed by the Ace, and leads the penultimate. *Z*, with his grand hand, commences a signal.

2. *B*, who can open nothing to advantage, returns the suit in the hope of making a small trump. *Z* completes his signal.

3. *A* develops the penultimate upon the third round, leaving his partner to draw the proper inference.

4. The lead through the signal is here forced. *A* must have numerical strength in trumps to play as he did. *A* knows by the play of the Eight that *B* has no other trump. *A* echoes notwithstanding the weak lead of trumps and the signal.

5. *Z* clears his suit before continuing trumps. The game seems to him a certainty.

6. *A* leads a trump to draw two for one. *B* is in some difficulty about the discard as *Z* has declared strength in trumps, but prefers to discard a Club as *A* must have also numerical strength in trumps. *Z* by the fall of the cards can count three trumps and two Spades in *A*'s hand.

7. Trifling with the game. He should here have led the two best trumps, and leaving *A* with the long trump, then have played C Q, in which event he must have won the game.

8. *A* cannot risk playing another trump. If the trumps are both in *Z*'s hand, *A* can never get the lead again. He therefore proceeds with his Spade suit. *Y* discards a Club to inform his partner he has not the Knave. *Z* takes advantage of this information and refuses to trump, trying, though in vain, to recover his position.

9. *A* continues with the last spade, and as *Y* discards another Club, *Z* knows the position of the Knave, and discards C 10, hoping to tempt *A* to lead a Diamond.

10. *A*, of course, plays the losing trump and throws the lead into *Z*'s hand, and *B* makes his D K. *A* and *B* make two by cards and the game, a result which would have been absolutely impossible if either one or other of the conventional leads had been adopted. The game is another instance of what so frequently occurs at Whist,—that a player endeavours to make more tricks than are necessary to win the game.

SIGNALS AT WHIST.

Is there not something antipodean in the question as to signalling in dispute between "Australia" and "Cavendish"? The former, apparently, would play *to win*, the latter certainly insists on the *mental exercise*. Accordingly, Australia would minimise, while Cavendish (to coin a word) maximises, the advantage given to quick observation, exact memory, and acute inference.

Given the original element of chance in the deal, the "signalling" system tends to make all the rest a trial of skill, and thus, surely, to add greatly to the interest of the game. In a game where nothing could be known (as in the imaginary case of *n* hands played simultaneously, taking *n* as the limit of memory) there could be no interest at all; the tricks might as well be thrown for on dice.

Q. T. V.

Our Chess Column.

BY MEPHISTO.

One Hundred Chess Problems. By the Rev. A. CYRIL PEARSON, M.A. Third Edition. (Civil Service Printing Company.)

THIS little volume, neatly got up, contains "a selection from those problems" composed by the author "which have stood the test of publication." The only additions to the third edition are four problems. The first was a highly successful competitor in the late *Chess Monthly* Problem Tourney, it being pronounced by the judges to be the finest problem in this important competition. The problem ably exemplifies a fine piece of strategy, and will bear favourable comparison with the first masterpieces of the English school. It reminds one of those exquisite gems by Grimshaw, the theme, which is both piquant and original, being not very unlike the style of this English master. This problem and No. 91 in the first series are undoubtedly the two finest conceptions of the Rev. composer.

The second problem is a three-mover. It has a pretty idea, and is remarkable for a few close shaves to second solutions. The composition is rather barren for want of variety.

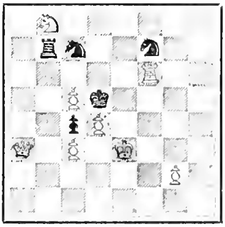
The third problem is a two-mover, the apparent novelty being that the White King moves from a position where he cannot be disturbed to a square where Black can administer six checks. So far the idea is good, but there being no ingenuity displayed in the method of averting the counter-checks and the number of inactive White pieces, I don't like it.

The fourth and last is a little amusing study after the American school; indeed, it can very appropriately be dubbed a Yankee trick. It is a sort of walking-up-stairs arrangement, perhaps intended as a classical illustration of a treadmill!

In the body of the work there are a few corrections made to the faulty positions which appeared in the first editions. Among the choicest of these are Nos. 33 and 49. No. 49 was a competitor in one of the "Westminster Papers" tourneys. No. 33 has a sweetly pretty conceit.

No. 33.

BLACK.

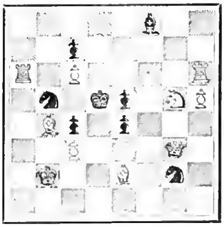


WHITE.

Mate in three.

No. 49.

BLACK.



WHITE.

Mate in three.

B. G. L.

SOLUTION.

PROBLEM, No. 104, BY B. G. LAWS, p. 296.

1. Kt to Q5	P tkes Kt, or 1.	1.	K takes Kt
2. Q to KB6	P to Q5	2. P to K4 (ch)	B takes P
3. Q to Q6, mate		3. B to Kt3, mate	
	If 2. K to K6		If 2. K takes P
3. Q to B4, mate		3. B to B3, mate	

If 1. B to Q6. 2. P takes B (ch), K takes Kt. 3. B to B3, mate.
If any other move, 2. Kt to B6, mate.

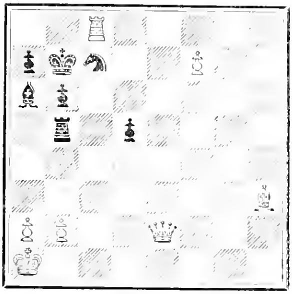
In reference to this problem, we have to acknowledge an error in

our answers to J. K. R., Berrow, and M. T. Hooton. If 1. P to K3, B to R2. 2. K to Kt4, B to Q6! Or if 1. Kt takes P, B to R2. 2. Q to B3 (ch), K to K4! and in neither case is there a mate on the move.

PROBLEM No. 105.

By J. W. Parsons.

Black.



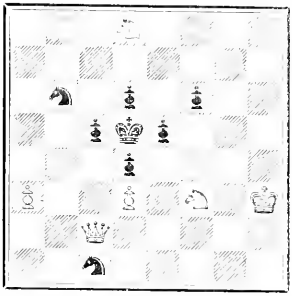
White.

White to play and mate in three moves.

PROBLEM No. 106.

By C. T. Gray.

Black.



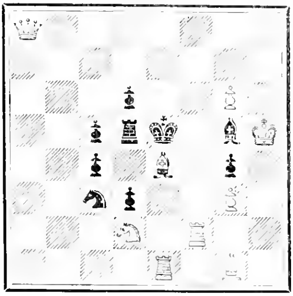
White.

White to play and mate in three moves.

PROBLEM No. 107.

By Frederick W. Markwick.

Black.



White.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please addres Chess Editor.*

A. de Watteville.—You send the following position:—White.—K, K3; R, KB sq; Kt, KR8; Ps, QB3 and 4. Black.—K, K4; PK2. We assume you intend the White Pawns to be on QB4 and 5, as otherwise the K could escape by way of Q3. If then, 1. Kt to Kt6 (ch), K to K3. 2. Kt to B8 (ch), K to K4. Now for his waiting move in order to force Black to play P to K3. The White R has *four* moves, viz., to B2, B3, B4, and B7; or White can also play K to Q3 with the same object. Finally, in reply to P to K3, White can mate either by Kt to Q7 or Kt to Kt6. You have therefore five duals, a most serious objection to a problem.

Berrow.—We regret to find your other problem too easy.

F. W. M.—The solution of No. 1 is rather too obvious.

J. Hughes.—Both your problems are incorrect. One can be solved by Q to Kt4 (ch), the other by Kt to Kt4.

Tom.—No. 1. P takes R spoils the mate. No. 2. R takes B.

P. G. R.—W., M. T. Hooton, best thanks for correction.

G. Woodcock.—Regret the delay of your letter of 3rd inst. The five prize problems correctly solved. We shall be pleased to find you an opponent for correspondence games.

Problem 104 correctly solved by W., W. Furnival, G. Woodcock, Rev. W. Anderson, H. A. N.

H. S. Simon, B. Gleam.—Solutions incorrect.

Contents of No. 107.

SPECIAL NOTICES.

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PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOV. 30, 1883.

CONTENTS OF NO. 109.

A NATURALIST'S YEAR.

By GRANT ALLEN.

THE REIGN OF EVERGREENS.

THE poor stripped and draggled garden is beginning to look very bare now of all except a few straggling late-flowering shrubs and those trusty adopted friends that we have always with us, the shrubby, large-leaved southern evergreens. In northern climates, we must ruefully admit, there are hardly any true evergreens, save only the conifers, with their stiff and needle-like foliage, such as pines and spruce-firs; but we make up for it to some extent by borrowing from warmer or more southern lands the laurels, aucubas, laurustinuses, and rhododendrons that help to keep bright our English lawns and shrubberies throughout the long and weary winter months. Indeed, our only native flat-leaved shrubs that retain their full greenness from year's end to year's end are privet, box, and butcher's broom, all three of them very doubtfully indigenous to these islands. It is the rule with English trees and shrubs to shed their foliage every autumn; and the fashion in which they do so shows very clearly how purposive and well-adapted to their conditions in life is the deciduous habit For the leaves do not merely tumble off anyhow, casually, before the first fierce autumnal wind; if they did so there would be loss of sap and of valuable food-stuffs to the whole plant of whose joint commonwealth they form the partially independent members: their fall is duly provided for beforehand, and when at last it actually takes place, it takes place in an orderly and regular fashion, with the least possible injury to the interests of the entire tree. From the very beginning there has been arranged at the joint where the leaf-stalk joins the stem, or where the separate leaflets join the central mid-rib, a row or articulation composed of cellular tissue, and specially designed to act as a joint for the dry leaves. When winter approaches, and chilly northern storms are likely to tear to pieces the leaves on the trees, all the protoplasm and other valuable cell-contents are withdrawn into the permanent tissues of the plant, leaving only the minor red and yellow colouring matters—mostly effete and used-up foodstuffs—which give so much beauty and glory to the general aspect of our autumn woodlands. Then the articulation dries up and withers, and the dead leaf separates at the joint, leaving behind it a regular mark or scar, which is the visible token of Nature's definite precaution against the northern cold and tempests.

It was not always so, however, and it is not so even now in the greater part of the modern world that we ourselves inhabit. It seems quite natural to us northerners that "leaves have their time to fall"; so natural, indeed, that we almost forget the strict limitation of the practice to our own chillier latitudes. Yet in reality the existence of deciduous trees is a mere temporary accident of the here and the now, a passing consequence of the great cold spell which had its culminating point in the last glacial epoch, and from whose lasting effects we ourselves are even still apparently suffering. Whether, as Mr. Alfred Russell Wallace seems hopeful enough to believe, our poor old planet may yet recover from this premonitory chilling or not—whether we may yet look forward to a few more warm spells or otherwise, before the final numbness of all dying worlds comes upon us, is a question rather for the consideration of astronomers and physicists than of the mere mundane-roving naturalist, with his petty ephemeral interests in our own plants and animals; but one thing at least is certain, that till a very recent period, geologically speaking, our earth enjoyed a warm and genial climate up to the actual poles themselves, and that all its vegetation was everywhere evergreen, of much the same type as that which now prevails in the modern tropics. Indeed, we have only to look at the existing state of things in order to see how very slight is the effect that has thus been produced upon our temperate flora. For example, among the oaks alone, there are some twenty species in Europe, of which southern Europe has eighteen, mostly evergreen, while north of the Alps there are only two, or at most three, all of them deciduous. From the evolutionary point of view it is clear that the northern kinds are modern developments, specialised to contend with the peculiarly cold conditions of sub-arctic Europe.

Fortunately, too, we are not left in this matter to mere conjecture or analogy: thanks to the researches of Heer and others, we have positive geological facts to guide us, which show conclusively that up to the Miocene period, Europe was covered by forests of large-leaved evergreen trees, of what we should now consider distinctively tropical types. Ever since the Miocene, and on to the culminating point of the great Ice Age, the European climate has been growing steadily colder, and the European flora has been at the same time steadily adapting itself to the new conditions, and to assuming what we now consider a typically northern aspect. During all that time, the large-leaved evergreens gave way before the deciduous trees and the chillier conifers, beginning at the north pole, and spreading gradually southward, as the cold deepened and widened its range. Since the end of the great Ice Age, and the subsequent slight amelioration of the climate in northern Europe, a reverse process has begun to set in; the arctic types have begun to recede slightly once more, and the comparatively southern or temperate types have pushed their way northward to occupy the place from which they were previously dispossessed by the newly-evolved kinds. It is not necessary for us here to inquire into the causes of this great cycle; the facts are there, and for our present purpose they are quite sufficient. They show conclusively, when one follows them out in detail, that the evolution of deciduous trees was concomitant with the growth of cold conditions around the two poles; and that such trees now exist only where winter extends for part of the year, rendering the evergreen condition an undesirable one. Even in the tropics, indeed, we find on high mountains a belt of

deciduous forest, stretching above the belt of large-leaved evergreens, which itself succeeds to the lowland palms and bananas and tree-ferns of the thoroughgoing equatorial plains.

The reason for the evolution of deciduous trees is of course to be found in the peculiar circumstances of the circumpolar regions. In the tropics, trees and plants can thrive and blossom all the year round; and even in temperate countries most small herbs and weeds gain by keeping their foliage throughout the winter; but big trees in cold climates would suffer much by the tearing and strewing of their leaves in winter gales, while they would obtain little advantage by retaining them on the tree during the long chilly season. Hence, if any tree happened to possess any arrangement by which dead or dying leaves could be removed without injury to the permanent tissues, while, at the same time, the useful materials were withdrawn into the young bark to await the spring awakening, such a tree would obviously enjoy an advantage in the struggle for existence, and would be likely to outstrip its evergreen neighbours in rigorous climates. Now, as a matter of fact, the germ of such an arrangement is found even in many herbs or small shrubs, such as, for example, the common pelargoniums or "scarlet geraniums" of our flower-gardens. Everybody who has ever kept these familiar plants in his own rooms must have noticed how easily the dead leaves separate from the stem at their base, by means of the swollen cellular mass where the leaf-stalk joins the axis. All that the forest trees of northern climates had to do, then, was just to take advantage of this nascent provision, wherever it existed (mark this prior necessity), and render it more fixed under the influence of natural selection. But, if we may judge by the actual sequel, it was not every kind of tree that could thus adapt itself to the altered circumstances; as a matter of fact, the number of species among northern forest-trees is very small indeed, and even out of this small number a good many are conifers, like the pines and yews, whose narrow, tough leaves are well fitted for withstanding and battling against all the wintry breezes. Still, among the conifers themselves there are a few species, such as the larches, with tender delicate foliage, which have also become deciduous under stress of altered conditions. At the present day the large-leaved and flat-leaved evergreens are mostly confined to tropical, sub-tropical, or at least warm temperate climates, and all the forest trees or the circumpolar tracts are either deciduous, or else are tough, leathery-leaved conifers. The laurels and rhododendrons, with which we strive artificially to brighten up our comparatively leafless English winter, are either hardy representatives of the warm temperate flora, or else mountain species from southern climates, with constitutions just strong enough to endure our chilly season in favoured and carefully selected situations. Such evergreens have generally very rigid and slimy leaves to protect them—a point well marked in ivy and laurel as compared with Virginia creeper and English hawthorn.

THE ZONE OF SMALL PLANETS.

By Richard A. Proctor.

My attention has been called to the circumstance that the theory of a shattered planet has been entertained of late by the most eminent philosopher of our age,—who, though not professedly an astronomer, has shown astronomers in other matters the way to reason correctly about the facts which they have laboriously collected. I was aware of this, but have had a reason for not dwelling on the point. Indeed it was the circumstance that the theory has seemed worthy of discussion by so clear-sighted a reasoner which induced me to reconsider it.

The reason which has chiefly directed attention of late to the explosion theory has been that the wide extension of the zone of asteroids seems inconsistent with the nebular hypothesis as advanced originally by Laplace. It has appeared to the powerful reasoner who has lately advocated the explosion theory, that, now the ring has been found to contain so many members, strewn at such widely different distances, the theory that they are portions of a nebulous ring which separated into several parts instead of collapsing into a single mass seems no longer tenable. Again "did a nebulous ring break up into numerous small portions, revolving round the Sun with approximately equal velocities, the annular series of them would inevitably have some point of least attraction between its adjacent members at which parting would take place, followed by collapse of its members upon one another till a single body was formed. Moreover, their mean distances from the Sun could scarcely differ so much that some are twice others: it could hardly happen the the annular space included between their most unlike mean distances would be more than 100 millions of miles across, and that the space occupied by the widest excursions would be 270 millions of miles across. Again the parts of such a ring could not well have orbits much inclined to one another, or much inclined to the average plane of the solar system as are sundry of the planetoid orbits. Further their orbits could not differ greatly in eccentricity as they do, one if not more of them to the extent of cutting the orbit of Mars. Surely no portion of an outer nebulous ring could thus intrude upon the region of an inner nebulous ring, at the same time that other portions almost intruded upon the region of a remoter nebulous ring. Once more, there could not arise any considerable difference between the times in which the discrete portions of such a ring revolved around the sun; to the extent of some being thrice others." All these traits of the planetoids, as Mr. Herbert Spencer truly says, are inconsistent with the supposition of Laplace as to the origin of the zone of asteroids.

The above reasoning is so thoroughly sound and convincing that I have ventured to quote it despite even the strong reason (based on Mr. Spencer's wishes) which I had had for treating this subject without any direct reference to his masterly essay on the Nebular Hypothesis. Indeed those who are astronomers by profession,—or at least surveyors of starfields—take so little interest in questions of this sort, that in dealing with them one must turn, of necessity, to the thoughts of men like Kant, Mitchel, Wright of Durham, Herbert Spencer, and others, who do not find in mere observatory routine the full value of what the heavens teach.

If, as I think is demonstrable, Olbers's explosion theory is absolutely inconsistent with the observed paths of the asteroids and with known physical laws, and if, as I think has been demonstrated above, the movements of the asteroids are inconsistent with the theory that they were formed by the breaking up of one of the rings of Laplace's nebular hypothesis, it would seem to follow that that hypothesis is either incorrect or incomplete. It has been so long my own belief (and the belief of many other students of the matter) that this is so, that I find nothing surprising in the recognition of other and perhaps clearer evidence of the fact than had before been obtained.

What, I would ask, is known about the laws of cohesion, of vaporous diffusion, of the interaction of the parts

of vaporous masses, which corresponds with Laplace's nebular hypothesis as originally advanced,—when as yet our knowledge of the physics of the subject was but in its infancy? Again, under what possible conditions and in what periods of time short of infinity, would the vaporous masses strewn around such a ring as that from which Neptune on this theory was formed, have coalesced into a single mass? Then, what account does the theory give of the meteoric and cometic matter which, we now *know*, must have been strewn amid the whole region in which Laplace set the vaporous embryon of the solar system, in quantity corresponding to no small aliquot portion of the mass of the planetary system? And lastly, what account does the nebular hypothesis as originally propounded give of the singular distribution of the masses which form the solar system?

Seeing that the theory of meteoric aggregation, duly combined with (but not subordinated to) the theory of vapourous condensation, accords not only with all the known facts but gives an account of all those chief peculiarities of the solar system with which the nebular hypothesis (alone) is actually inconsistent, it is with *this* theory that the characteristics of the zone of minor planets should be compared. I think I shall be able to show that, when this is done, instead of discord and difficulty we find clear and convincing evidence respecting the evolution of the solar system, and also information as to the way in which that process was brought about.

(*To be continued.*)

SEA ANEMONES

AT THE RECENT FISHERIES EXHIBITION.

By Thomas Kimber.

IX.—THE DAHLIA.

(*Continued from page 306.*)

THIS is a chapter on gastronomy, showing the best-known methods—unknown probably to Professor Buckmaster and the Kensington School of Cookery—of cooking Crassicornis. The following recipes are taken *verbatim*, with the kind permission of the author, from "A Naturalist's Rambles on the Devonshire Coast," by P. H. Gosse, F.R.S. The testimony of Abbé Dicquemare, referred to by Mr. Gosse, of the excellency of boiled Crassicornis we gave in our last communication on page 306.

"And now for a paragraph on cookery.

"Dicquemare's testimony to the excellence of *actinia crassicornis* for the table tempted me to taste it, and I determined to take an early opportunity of cooking a few. In a few minutes I collected some half-a-dozen of different sizes at low water near Wildersmouth, and having rubbed them with my fingers in a tidepool till the coating of gravel was pretty well got rid of, brought them home. I put them into a pan of sea-water for the night to cleanse them, and most beautiful and gorgeous was the appearance they presented when expanded—no two alike in colours, and yet all so lovely that it was difficult to say which excelled. Perhaps one with the tentacles partly cream-colour and partly white was as beautiful as any.

"The next morning, however, I began operations. As it was an experiment, I did not choose to commit my pet morsels to the servants, but took the saucepan into my own hand. As I had no information as to how long they required boiling, I had to find it out for myself. Some I put into the water (sea-water) cold, and allowed to boil gradually. As soon as the water boiled, I tried one; it was tough—evidently undone. The next I took out after three minutes' boiling. This was better; and one at five minutes was better still, but not so good as one which had boiled ten. I then put the remaining ones into the boiling water, and let them remain over the fire boiling fast for ten minutes, and these were best of all, being more tender, as well as being of a more inviting appearance.

"I must confess that the first bit I essayed caused a sort of lumpy feeling in my throat, as if a sentinel there guarded the way, and said, 'It shan't come here.' This sensation, however, I felt to be unworthy of a philosopher, for there was nothing really repugnant in the taste. As soon as I had got one that seemed well cooked, I invited Mrs. G. to share the feast. She courageously attacked the morsel, but I am compelled to confess it would not pass the vestibule—the sentinel was too many for her. My little boy, however, voted that 'tinny was good,' and that 'he liked tinny,' and loudly demanded more, like another Oliver Twist. As for me, I proved the truth of the adage, *Ce n'est que le premier pas qui coûte;* for my sentinel was cowed after the first defeat. I left little in the dish.

"In truth, the flavour and taste are agreeable—somewhat like those of the soft parts of crab. I ate them hot, with the usual crab-condiments of salt, pepper, mustard, and vinegar, mixed into a sauce. The internal parts, including the ovaries and the tentacles, though, from their mottled appearance, rather repelling to the eye, were the most agreeable in taste; the integuments somewhat reminded me of the jelly-like skin of a calf's head. I wonder they are not commonly brought to table, for they are easily procured, and are certainly far superior to cockles, periwinkles, and mussels. After a very little use, I am persuaded anyone would get very fond of boiled Actinias.

"Some I had left, with a little gravel still adhering, in order to see whether this would be thrown off when life departed; but it was not so. They should be cleansed before cooking, which can be easily and quickly done with the fingers under water; the base also should be scraped, so as to remove any bits of slate, or rock, or dirt that adhere to it. Attention to these particulars greatly improves the appearance when cooked. They are of a pellucid rosy hue, of a firm consistence; at least sufficiently firm to be readily cut with a knife.

"The next that I tried were prepared in a different manner, and, truth to say, the experiment was far more successful this time. I cleansed them more perfectly, carefully scraping the bases until they were freed from every particle of extraneous matter and from slime. These I had fried in egg and bread-crumbs, and they were far superior to even the best on the former occasion.

"All prejudice yielded to their inviting odour and appearance, and the whole table joined in the repast with indubitable gusto. I know not if my readers are familiar with a dish which in Newfoundland during the cod-fishing season we used to consider worthy of an epicure—the tongues of the cod taken out as soon as the fish are brought on shore, and fried immediately. The Actiniæ fried, as above described, I should scarcely be able to distinguish, either by the eye or by the taste, from fresh cod's tongues, except, perhaps, that my *protégés* are slightly firmer in consistence.

"*Anthea cereus* I subsequently tried prepared in the manner last mentioned. They, too, were savoury; but the sliminess of their tentacles was somewhat disagreeable. They are far less substantial, in proportion to their apparent size, than the Actiniæ—little, indeed, remaining, but a mass of tentacles. When Johnston speaks of the

'h t and peppery *Anthea*' I presume he glances at its urticating properties, for there is no pungency in its taste."

Dr. Johnston ("History of Brit. Zoophytes," vol. i. p. 236) asserts that sea anemones are so very sensible to atmospheric changes that they foretell the weather as certainly as a barometer.

When they remain naturally closed there is reason to fear a storm, high winds, and a troubled sea; but a fair and calm season is to be anticipated when they lie relaxed with spread-out tentacula. The observations of Dicquemare are the foundation for these conclusions, which are as follows:—

"My very earliest observation showed that the sea anemones feel and prognosticate, within doors, the different changes of temperature in the atmosphere. I had not leisure at that time to form tables of their various indications, but I have since done it. This fact, if applied to practice, might be of use in the formation of a sea barometer—an object of no small importance, which several ingenious men have hitherto endeavoured in vain to furnish us with.

"If my anemones be at any time shut or contracted, I have reason to apprehend an approaching storm—that is, high winds and an agitated sea. When they are all shut, but not remarkably contracted, they forebode a weather somewhat less boisterous, but still attended with gales and a rough sea. If they appear in the least open, or alternately and frequently opening and closing, they indicate a mean state of both winds and waves; when they are quite open I expect tolerably fine weather and a smooth sea; and lastly, when their bodies are considerably extended and their limbs divergent, they surely prognosticate fixed fair weather and a calm sea. There are times when some are open and others shut. The number must then be consulted—the question is decided by the majority. The anemones used as barometers should not be fed, for then the quantity of nourishment might influence their predictions."

THE EXTINCTION OF THE MASTODON.—Professor John Collett's Geological Report of Indiana for the year 1880 states that the mastodon was in existence in North America much more recently than is generally supposed. Thirty individual specimens have been discovered in Indiana, almost always in marshes, ponds, or other miry places, indicating at once the cause of the death of the animal and the preservation of the bones from decay. Spots of ground in this condition are found at the summit of the glacial drift or in old beds of rivers which have adopted a shorter route and lower level; consequently, their date does not reach beyond the most recent changes of the earth's surface. A skeleton has been discovered in excavating the bed of the canal a few miles north of Covington, Fountain county, in wet peat. The teeth are in good preservation, and it is stated that when the larger bones were cut open the marrow, still preserved, was utilised by the bog-cutters to grease their boots, and that pieces of sperm-like substance, 2½ in. to 3 in. in diameter (*adipocere*) occupied the place of the kidney fat of the monster. During the summer of 1880, an almost complete skeleton of a mastodon was found six miles northwest from Hoopston, Iroqouis county, Illinois, which practically settles the question not only that it was a recent animal, but that it survived until the life and vegetation of to-day prevailed. The tusks formed each a full quarter of a circle, were 9 ft. long, 22 in. in circumference at the base, and in their water-soaked condition, weighed 175 lb. In the same bed of miry clay, a multitude of molluscs was collected. These molluscs prevail all over the States of Illinois and Indiana, and parts of Michigan, and show conclusively, says Professor Collett, that the animal and vegetable life, and consequently climate, are the same now as when this mastodon sank in his grave of mire and clay.

THE OCCUPATIONS OF THE PEOPLE

IN ENGLAND AND WALES IN 1881.

(From the last Census.)

By Percy Russell.

BEARING in mind the many momentous problems before us political, social, and industrial, the third volume of the Census of England and Wales for 1881, relating, *inter alia*, to the occupations of the people, certainly possesses extraordinary interest, and necessarily throws considerable light on what may be called the discipline of the nation. To properly examine such an enormous mass of tabulated matter would be impracticable within reasonable limits of space; but I propose to extract a few salient results from these valuable returns, and contrast them with those of the 1871 Census.

It appears, then, that in 1881 the total population was 12,639,902 males, and 13,334,537 females, against 11,058,934 males and 11,653,332 in 1871. Taking the six great groups into which the nation is here divided, we find that whereas in 1871 the total population of 22,712,266 was divided thus:—Professional class, 684,102 (including 197,984 females); domestic class, 5,905,171 (including 5,660,443 females); commercial class, 815,424 (including 57,237 females); agricultural class, 1,657,138 (including 186,696 females); industrial class, 5,137,725 (including 1,521,998 females): and finally indefinite and non-productive class, 8,512,706 (including 4,028,974 females). The corresponding figures for 1881 are:—Professional class, 647,075 (including 196,120 females); domestic class, 1,803,810 (including 1,545,302 females); commercial class, 980,128 (including 19,467 females); agricultural class, 1,383,184 (including 64,840 females); industrial class, 6,373,367 (including 1,578,189 females); and indefinite and non-productive classes, 14,786,875 (including 9,930,619 females), and this with a total population of 25,974,439. It will be seen that the "professional class" is considerably reduced in numbers, no doubt owing to a very strict classification, although there is but a small difference in those of the females thus returned. The domestic class has evidently been differently compiled, wives and children being carried over to the sixth table of the present returns. The commercial class exhibits a marked increase from 815,424 to 980,128, but as the females are put at only 19,467, it may be supposed that a more rigorous interpretation has been put on the term than in 1871, when 57,237 females were returned under that head. The agricultural class, as everybody anticipated, shows an enormous reduction from 1,657,138 in 1871 to 1,383,184; while the industrial class has advanced from 5,137,725 in the former period to 6,373,367 in 1881. The difference in the returns under indefinite and unproductive indicates a change of classification, being 8,512,706 in 1871, against 14,786,875 in 1881. This and some other alterations, rendering precise comparative analyses of the two groups of statistics difficult and intricate, scarcely enhance the value for popular exposition of the new, and in other respects valuable and excellently-arranged, records.

Passing from the great classes to orders, it is noteworthy that whereas in 1871 the Government of the country absorbed the services of 106,286 persons, including 6,394 females, in 1881 the corresponding figures were 104,592, including 7,370 females, a reduction on the gross total, but a significant increase in the number of females. Defence in 1871 occupied 136,491 persons, against only

124,580 in 1881. Turning to the principal professions, the results are equally significant. Thus in 1871 the clerical profession numbered 44,562, against 51,120 in 1881; law, &c., 37,327, against 43,641; medical, 44,214, against 64,548; teachers, 127,140, against 171,831; scientific persons, 6,192, against 8,394; artists, 16,562, against 58,517; authors, editors, and journalists (males) 2,148, against 2,982; and females, 255 against 452. The increase in all these departments of intellectual culture is very noticeable, more particularly in reference to art, and shows conclusively what extraordinary advantages have been gained during the period by the people in respect to the agencies for their instruction, entertainment, and refinement. It is also obvious that women are now playing a very much more prominent part in the great works of the nation than at the former period of comparison. Thus, according to the census of 1881, while the number of male teachers was 39,738 that of female teachers was put at 94,241. In 1871, the cor.esponding figures were 19,378 and 38,774. A remarkable contrast.

In 1871 the number of commercial clerks was 89,630, whereas in 1881, the number is set down at 175,468, an increase evidently out of all proportion to that of the population during the period. At the former period the females returned as "clerks" were 1,412 strong; now, according to the late census, they number 5,989. Against this remarkable growth of the subordinate rank and file of the commercial class, we have to see the fact that whereas in 1871 the number of merchants was returned at 15,903, in 1881 these appear reduced to 10,308. Bankers, too, have fallen from 1,287 to 1,052, but, *per contra*, brokers' agents, &c., have increased from 22,776 to 30,697, and commercial travellers have augmented from 17,895 to 35,478.

The "General Labourers'" class has increased from 509,456 to 556,876. In the Returns for 1871 in the general summary, we have under the heading Persons of Rank and Property, 25,510 persons set down as answering in some way or other to the "upper ten." In the present tables under 24th section of Table 6, we find 4,856,256 persons returned as of property or rank, and including all children under five years of age. I fail entirely to see what is the use of such an item as this.

The section devoted to the Occupations and Country of Birth of Foreigners is not without interest. In the National and Local Government, East Indian and Colonial services, there are only 28 aliens, and of these 25 are natives of the German Empire. Among the clergy there is a more considerable foreign element. Taking the Established Church we find 4 Austrians, 4 Swiss, 18 Germans, 3 Italians, 2 Norwegians, 7 Russians, 3 Poles, 4 natives of Holland, and 5 of France. Of Roman Catholic Priests, 6 are Austrians, 8 Swiss, 105 Germans, 45 Italians, 2 Greeks, and, strange to say, 2 Turks; there were, too, 28 natives of Holland, 67 of Belgium, 119 of France, and 10 of Spain. Law does not favour foreigners much, there being only 32 among the whole body of barristers, solicitors, law clerks, &c., of alien birth, and of these 11 are Germans. In literature the foreign element is by no means strong. Of authors, editors, and journalists 6 are Austrians, 2 are Hungarians, 1 is a Swiss, 28 are Germans, 5 Italians, 1 is a Dane, 3 are Russians, 11 French, 10 Portuguese, 2 natives of Holland, 1 Pole, 1 Belgian, and 3 Greeks. Only 14 foreigners are returned as reporters. Of painters, 15 are Austrians, 2 Hungarians, 4 Swiss, 98 Germans, 42 Italians, 2 Greeks, 7 Danes, 4 Swedes, 8 Russians, 4 Poles, 35 Belgians, 111 French, 6 Spaniards, 16 natives of Holland, 1 Norwegian, 1 Portugese, and, curiously again, 1 is a Turk. Only 13 aliens are returned as architects, and that out of a total of 6,898. Musicians, as may be imagined, furnished one of the largest contingents; they are as follows:—Natives of Austria, 25 males, 6 females; Hungary, 6 males, 1 female; Switzerland, 17 males, 8 females; Germany, 786 males, 94 females; Italy, 1,017 males, 223 females; Greece, 2 females; then there were 5 Danes, 2 females; 4 Norwegians; 6 Swedes, 5 females; 7 Russians, 5 females; 8 Poles; 45 natives of Holland, 7 females; 40 Belgians, 11 females; 74 French, 44 females; 4 Spaniards; 1 Portuguese; and 1 Turk. Those who are now exercised in their minds regarding the status and prospect of our ordinary commercial clerks will be interested to have the precise statistics of the foreigners now competing in this over-crowded department of industry with "Our Boys." Turning to the table for 1881, it appears thence that of commercial clerks of alien birth Denmark sent us 101 and 2 females; Norway, 77; Sweden, 100; Russia, 56, and, singularly enough, 1 female; Poland, 21; Holland, 137, and 2 females; Belgium, 78, and 4 females; France, 351, and 9 females; Portugal, 25; Spain, 65; Italy, 88, and 1 female; Greece, 42, and 1 female; Turkey, 33—it will be noticed that the Turk is remarkably represented in the industries of this country; Roumania, 3; and last, and most formidable of all, Germany sends us 1,781 males and 14 females in this capacity. In 1871 Germany sent us 1,257, the total then of foreigners employed in England and Wales as clerks being, all told, only 2,498.

A patient search will, of course, unearth many curiosities of the Census. Thus, in the returns devoted to the blind it is somewhat surprising to find that the number of the blind has risen from 21,590 in 1870, to 22,832 in 1882. Blindness appears to prevail chiefly among musicians (males 496, females 70); agricultural labourers, &c. (males, 574, females, 21); matmakers (males 158, females 5); and carpenters (males 120). Touching deaf and dumb persons, four are in the Civil Service, three as messengers; one is a soldier, and, most strange of all, one is returned under the head Minister or Priest, and nine persons thus afflicted are recorded as Missionary Scripture Readers and Itinerant Preachers (!) As to lunatics, these have increased from 39,567 in 1871, to 51,786 in 1881. I might easily multiply examples of odd things from these voluminous returns, but those cited here may suffice, perhaps, to indicate the sterling value and interest possessed by this the third volume of the Census for 1881 regarded as a whole.

A HEAD, says the *Panama Star and Herald*, taken from a monolith at Tiahuanaco, has been erected in La Paz, Bolivia. Some time ago General Ballivian attempted to transport the monolith intact, but, after removing it some distance, the work was found to be difficult and the effort was given up. This stone is eight mètres in length. The head which has now been taken to La Paz weighs 2,700 lb. It must be remembered that the ruined city at Tiahuanaco is celebrated for the massive nature of the stones employed in the erection of its temples, fortresses, and houses. In one of the walls there is a gigantic mass of rock, which has been carefully measured and proved to weigh 250,000 lb., or 125 short tons. Who were the builders, and how they contrived to handle these enormous masses of rock remain enigmas to the present day, although fancy and tradition have been busily employed endeavouring to solve them. Tiahuanaco is situate in Bolivia on the south shore of Lake Titicaca.

TRICYCLES IN 1883.

By John Browning,

Chairman of the London Tricycle Club.

PROTECTING MACHINES FROM WEATHER, MENDING TYRES, AND RIDING IN WINTER.

THOSE tricyclists who do not ride during the winter should cover all the bright parts of their machines, whether plain steel or nickelised, with a good coating of vaseline, which can be applied best with a small hog-hair brush. This will be found a complete protection against any amount of damp, or even wet. No other material will bear comparison with it as a rust preventive.

Those who do ride occasionally should apply a small quantity of vaseline very thinly with a piece of rag. This will scarcely be seen, but it will serve a double purpose—it will protect the bright parts and prevent mud from adhering strongly, and thus facilitate their being cleaned. In my own case, I apply it to the painted parts of the machine and also to the leather satchels and straps, as it keeps them flexible and prevents them from cracking or becoming mildewed.

I must here express my regret at the number of tricyclists who ride only about six months in the year. Bicyclists are almost compelled to give up riding during the winter months, as they cannot steer their machines, which are always in a condition of unstable equilibrium when the wheels fall into ruts, or they come across loose stones, which, in these months, are so plentiful; nor can they altogether avoid most dangerous falls from their wheels slipping sideways upon frozen snow or ice.

But tricyclists can use their machines in any condition of the roads. A low gearing, from 36 in. to 46 in., according to the weight of the machine and the rider's strength, and a good-sized tyre—that is, from $\frac{3}{4}$ to $\frac{7}{8}$ of an inch diameter—will carry him through any mud and over any stones; though I should advise new stones being walked, not ridden, to save the rubber tyres.

When, however, the roads are frozen hard—the most difficult of all conditions for a bicyclist to ride—the tricycle rider may enjoy a pastime superior even to skating.

I shall never forget, one bright, frosty Christmas day, how I spent the afternoon on wheels with my two earliest and best friends in the wheel-world; how we spun along over the frozen ground, hardly feeling the exertion; and now we finished our run by gliding down hill for between three and four miles with our feet up on the rests, at the rate of something very little less than twenty miles an hour. Nor shall I forget how the following year, with the same dear friends, I rode the old year out and the new year in on a clear moonlight night, through a landscape covered with snow. Still, it must be admitted that there are some days in our winter on which the most enthusiastic rider would scarcely be tempted to ride. Such days may be taken advantage of to mend the cuts in the rubber-tyres.

Mr. Bennett has recently shown me an excellent way of doing this. First, get some indiarubber solution, or cut up a piece of old tyre into fragments about half an inch square, and put them into a wide-mouth, glass-stoppered bottle, then pour in just sufficient turpentine to cover them; let the bottle stand until they swell, and then put it into a slow oven, where, in a short time, the turpentine and rubber-tyre will run into a jelly. Now, with a small piece of thin wood, in the form of a spatula, fill the ruts in the tyres with this jelly. Wait until the turpentine has evaporated, so that this cement becomes thick and strongly glutinous. Then insert a small wedge of old rubber tyre into the cut, and leave it until the cement is firmly set. When this is the case, the top of the wedge, which should project above the tyre, should be trimmed off with a sharp knife, kept wetted.

One gentleman informs me that he has had his rubber tyres badly gnawed by rats, and that he believes this arose through the oil-cups of the wheels having been allowed to hang downwards, so that the oil dripped on to the tyres, and softened the rubbers; and the rats were only tempted to gnaw these for the sake of the oil which had soaked into them.

In any case it would be well in leaving a machine to take care that the oil-cups are carefully turned upwards, as oil alone will completely destroy rubber by reducing it to a jelly.

At the urgent request of several correspondents, I shall shortly write an article, or articles, on "How to Choose a Tricycle."

A MARINE MONSTER.

By Richard A. Proctor.

THE discovery of a strange sea creature near St. Elmo, illustrates the truth of what I had remarked a few days earlier as to the smallness of our knowledge of the denizens of the mighty deep. The case is interesting not only in its bearing on the accounts of sea monsters of species as yet unknown, but also because it seems as though in the present case evidence of the existence of a tolerably numerous race of creatures had been obtained. To begin with, the account is not characterised by any evidence of an attempt to excite wonder by untruths. The animal seen, though unlike any known, would not be in itself very marvellous. Omitting details of no importance, the account runs thus:—While the boats of Capt. Seymour's barque, *Hope On*, were on the watch for whales off the Pearl Islands (between forty and fifty miles from Panama) the water broke a short distance away, and Capt. Seymour made ready for a whale. But a head like that of a horse rose from the water and then dived. The creature was seen by all the boat's crew. Capt. Seymour describes the animal as almost twenty feet in length, with a handsome horse-like head, with two unicorn-shaped horns protruding from it. The creature had four legs or double-jointed fins, a brownish hide, profusely speckled with large black spots, and a tail which appeared to be divided into parts. The creature was seen on two different days, and if whales had not been about at the time, an effort would have been made to catch it. Captain Seymour and his officers agree in considering that the creature is peculiar to the locality, and that it could easily be killed with lances and guns. It is important to notice that officers of the Pacific Mail Company state they have seen the animal on several occasions, but not so closely as did the officers and men of the *Hope On*.

The nearest account of any strange animal akin to that seen by Captain Seymour and his men, is the account of a marine creature, supposed to be a sea serpent, seen in 1817 near Cape Ann, Massachusetts. Eleven witnesses of good reputation gave on oath before magistrates—one of whom had himself seen what they had—a description of a creature like a serpent, dark brown in colour (some said mottled), with white under the head and neck. The head of this creature was as large as a horse's, but shaped like a serpent's; and the animal was estimated as exceeding 50 ft. in length. Colonel Perkins noticed an appearance in the front of the head like a single horn; but other observers thought this was the monster's tongue.

The evidence now obtained confirms the theory which was advanced in 1848 and has since been maintained by Gosse and others, that a race of marine animal exists, including probably several varieties, which is characterised by a serpentine neck, a head small compared with the body, but large compared with the thickness of the neck, an air-breather, and deriving its propulsive power from paddles—in other words, a modern representative of the long-necked plesiosaurians of the great secondary or mesozoic era. Creatures of this class have been aptly compared to what would be formed by drawing a serpent through the body of a sea-turtle. —*Newcastle Weekly Chronicle*.

THE AMATEUR ELECTRICIAN.

BATTERIES VI.

An inexpensive, but at the same time efficient, form of bichromate battery may be constructed with but very little trouble. When a comparatively powerful current is required, it is generally speaking more advantageous to use a number of small plates, in preference to a pair of large ones. In Fig. 1 is illustrated a combination of five

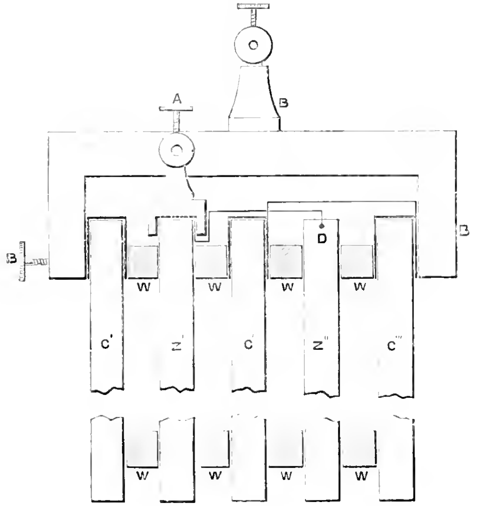


Fig. 1.

plates—two of zinc and three of carbon. The same general arrangement will do for any number of plates, providing that the number of carbons always exceeds that of the zincs by one. Six inches by three inches will be found a very convenient size for the plates, the zincs being a quarter of an inch thick. The thickness of the carbons is not very material, except for convenience' sake. They are, however, usually sold about a quarter of an inch thick. In fitting-up, the zincs and carbons should alternate, as shown in Fig. 1 (CZCZC), and should be separated at the bottom by strips of wood (W W) about three inches long and a quarter of an inch in section. The carbon plates should previously be capped by bending over the top of each carbon a strip of thin sheet lead. The lead answers the double purpose of keeping the solution from the upper portions of the cell, and of insuring good metallic connection. A small brass terminal or binding screw (A) should also be soldered or screwed on to one of the zinc plates (Z^{I}), and should embrace also the free end of a piece of copper wire, soldered (as at D) to the other zinc plate (Z^{II}). A stout brass clamp or binding screw (B) holds the arrangement together at the top, and connects the external carbons (C^{I} and C^{III}). The lower portions being kept in position by means of a stout india-rubber band (not shown in the diagram), a piece of copper wire, or a strip of thin sheet copper clamped at one end between the lead cap of the centre carbon (C^{II}) and a contiguous wooden rod (W), and at the other end between the terminal (B) and the lead cap of the external carbon (C^{III}) places C^{II} in electrical connection with the other carbon plates. A and B afford the requisite facilities for connecting the battery to the circuit through which the current is designed to travel. The series of plates may be placed in an earthenware or other non-porous vessel of suitable dimensions, say four inches in diameter and five and a-half inches deep.

For the solution, dissolve bichromate of potash in boiling water until the solution becomes a saturated one, and add to it about one-tenth the volume of sulphuric acid.

As the solution is a highly corrosive one, it is advisable to coat all exposed metallic surface with pitch, sealing-wax varnish,* or some other unassailable substance.

The plates should only be kept in the solution when a current is required, and some device for accomplishing this is necessary. With expensive forms, such as the bottle bichromate (see Knowledge, No. 105), this object is attained by supporting the zinc plates at the end of a long brass rod, which slides tightly in a vertical tube, a small nut being used to keep the rod in any desired position. The carbons in this case remain in the solution. Where there are several cells in use they are placed in a kind of box, and all the plates are attached to a rod which is raised by means of a strong cord controlled by a winding arrangement. An equally efficient device is to stand the cells on a board, carrying at each extremity an upright about twice the height of the cell, one of them being so shaped as to allow a rod, to which the plates are attached, to be lifted and lodged in grooves cut in the upper end of each upright. With a single cell, however, the best and cheapest plan is to use a second glazed earthenware jar, and after washing the plates (without taking the arrangement to pieces), place them in it, and let them remain there till the cell is again required.

Double liquid bichromate cells are very numerous in form and constitution. The simplest is that in which a bichromate of potash solution replaces the nitric acid in the Bunsen cell. It is found to give good results, and we have used them at various times during the past ten or twelve years with great success. The cell yields a current almost equal to the Bunsen; it is more durable, more constant, more economical, and gives off a much smaller quantity of fumes, which are also of a less obnoxious nature. As a result of considerable experience, it is found that the depolarisation of the negative plate, or, in

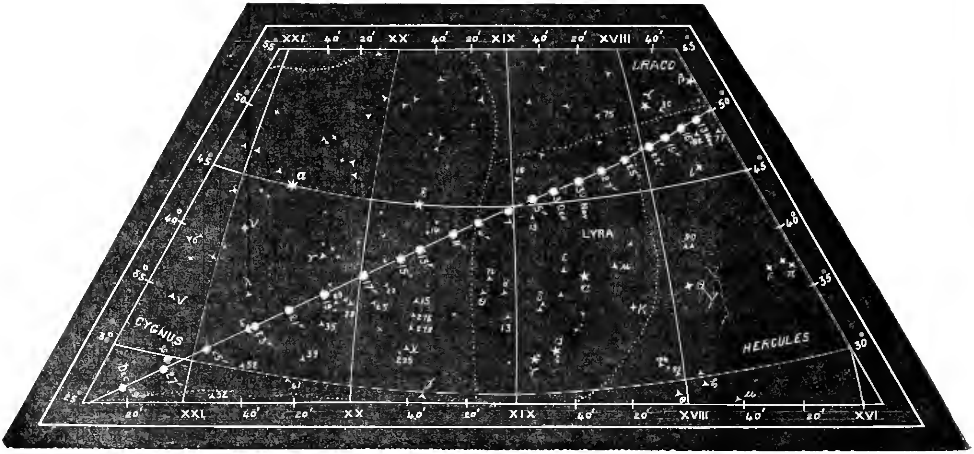
* An extremely handy mixture, which may be prepared by dissolving good shelllac in methylated spirit, until the solution is of a consistency suitable for the particular purpose for which it may be made, and then adding a very small quantity of vermilion, sufficient only to give the desired tint. It is better to prepare the solution in this way than to use manufactured sealing-wax, which generally contains foreign ingredients of an injurious nature. The varnish must not be too thick, otherwise it will take an unnecessarily long time in drying. If too thin, there is a wasteful consumption of spirit. Experience will best indicate the most advantageous consistency. The varnish may be kept for a long time if well bottled.

simpler language, the combination of the nascent hydrogen with oxygen of the bichromate of potash, proceeds less rapidly than might be desired. The result is that the constancy of the cell is materially impaired. To overcome this difficulty several devices have been brought forward. Amongst them is the pneumatic cell, in which air is forced into the cell at the bottom of the plates, and, rising through the solution, carries off the hydrogen as it collects on the carbon plates. This arrangement also serves to keep the solution in motion, constantly supplying fresh salt to the plates. The cell cannot, however, be regarded as a very practical one, and we shall soon consider others which achieve a similar object in a less troublesome manner.

PONS' COMET.

THE comet (Pons-Brooks) was observed by me in Liverpool, November 17, between 6 h. 15 m. and 7 h. p.m.; the right ascension being 17 h. 44 m. declination north 49° 36′. It has greatly increased in brilliancy since October 3, shining as a star of the 7th magnitude; with a magnifying power of 30, a stellar point could be discerned, situated eccentrically within the elongated disc. It may be found with a field-glass, and is a comparatively easy object in a telescope of two inches aperture. The perihelion passage takes place on Jan. 14, 1884 (in right ascension 23 h. 12 m., declination south 1° 10′), at a distance of 53° from the sun. This comet, whose identity with that of 1812 has now been proved, was discovered by Pons, of Marseilles, on July 20, 1812, in the constellation Lynx. It shortly afterwards developed a tail 2° long, and was visible to the naked eye for ten weeks. The portion of the heavens represented in the map is taken from Proctor's "Star Atlas"; the path of the comet from November 13 to December 29 is projected from Chandler's corrected elements of Schulhoff and Bossert. On Jan. 30, 1884, it will be in Cetus, on February 13 in Sculptor, and after the latter date will be invisible in these latitudes, owing to its great southerly declination.

W. K. Bradgate.



Reviews.

EVOLUTION AND NATURAL THEOLOGY.*

By Edward Clodd.

THIS is a book of much interest from the pen of a ready writer. Mr. Kirby has already scored honours in the scientific world as an expert in entomology, and his experience in classification serves him in good stead in the arrangement of the mass of material, which, in a volume of about 200 pages, can be treated only in a summary fashion. Whilst, however, neglecting no important feature of the theory which he expounds, Mr. Kirby has shown literary skill in preventing his little book from becoming a mere catalogue. As will be seen presently, the space given to matters which are no essential part of the theory of evolution is to be regretted, because it might have been devoted with advantage to more detailed reasoning in support of that theory. From the like cause, the arguments in its favour furnished by philology and by the important transitional forms of organisms, are tantalisingly meagre, whilst the discussion upon Sir William Thomson's *bizarre* theory of the origin of life—namely, that if a mass of matter from an inhabited world fell upon an uninhabited world, the adhering germs would in time stock that world with life—could have been well spared. The work opens with a well-condensed sketch of ancient speculation concerning the earth and its place in the universe as contrasted with modern theories founded on observation and experiment, and in succeeding chapters the steps by which scientists of the eighteenth and nineteenth centuries have been led to substitute for the old theories of special creation and the fixity of species theories more tenable, which have finally culminated in the brilliant generalisations of Mr. Spencer and Mr. Darwin, are clearly laid down. Mr. Darwin's explanation of organic evolution is then passed in review, and the general body of evidence upon which it is based summarised, with the needful quali-

* "Evolution and Natural Theology." By W. F. Kirby, of the British Museum. (W. Swann, Sonneschein, & Co. 1883.)

fication that natural selection is probably not the only agent in causing variations of species.

No one can rise from the careful perusal of the first eleven chapters of this book without feeling that the author has succeeded in infusing into the mind of the reader a deeper consciousness of the unity which underlies the most varied phenomena, and in preparing him to accept the doctrines of the evolution of the organic from the inorganic "by the regular action of the unchangeable order of Nature," and of the probable ultimate homogeneity or sameness of the inorganic elements of which the visible universe is built up."

Thus far all is clear and self-consistent, but when, in his chapter on the "Course of Development on the Earth," Mr. Kirby plunges us into theories of intermediate spirits "guiding the operation of the ordinary laws of Nature,"* of the pre-existence and successive metamorphoses of disembodied spirits, to the existence of which all ages, he remarks, have furnished "a vast amount of testimony";† of the immortality of brutes and plants; we are no longer on the solid, but caught up into a sphere where we hear language untranslatable. From the title of the book itself, as from remarks scattered throughout, we gather that the complexion of the author's mind is towards the high matters just named; that, in fact, they are the chief occasion of his work being written, and the importance of deciding on their admission or dismission must justify reference to them in this notice.

Whilst in the earlier part of his book Mr. Kirby admits that man is no exception to the common structural type, in the chapter under review he contends for an exceptional mode of development.

Wallace, in his essay on the Limits of Natural Selection, as applied to man, argues that we may trace in Nature, and especially in the origin of man, the action of intelligences controlling the action of natural law for definite ends. . . . Any beings which may be supposed to exist, must necessarily exist only by the will of God, and must exist through, and subject to, the limitations of the laws of Nature, or, to speak more correctly, the will of God, as man himself. . . . Man possesses considerable power over the lower animals and over his fellow men; and there is, therefore, nothing unreasonable in Wallace's view that other beings may have power over the development of man, especially when we consider that it cannot be satisfactorily accounted for by the operation of those ordinary physical agencies which are frequently spoken of as the blind forces of Nature.‡

We promise Mr. Kirby not thus to speak of them, our feeling of the immanent life in the universe being as deep as his own, although not quickened by such imaginings. But in the above quotation we see the effects of what Mr. Spencer calls the "theological bias," which, whether it be born of the intuitional philosophy or of the doctrines of Swedenborg or Rome, refuses to apply the theory of evolution to the complete nature of man, speaks of laws of Nature as entities, and of matter as if its ultimate nature was proven to be the opposite of spirit. Either man is a part of nature, or he is not; if he is, then the theory of evolution must embrace the genesis and development of mind with all that it involves; if he is not, then let us not coquet with an illusion, but return to our first love, to belief in Adam, as the father of us all, created of dust, and made a living soul by the breath of a Personal God. Between these two positions there is no room for the hypothesis of intermediate intelligences, and the evolutionist and the believer in special creation will alike resent them as an intrusion and an impertinence. Those who, whilst professedly following the scientific method, assume their existence, ignore that principle which Sir William Hamilton calls the Law of Parsimony, which forbids us to invoke the operation of higher causes when lower causes are found sufficient to explain the effects. Such chimeras remind us of Emerson's remarks on the three heavens and the three orders of angels of Swedenborg. "His spiritual world bears the same relation to the generosities and joys of truth of which human souls have already made us cognisant, as a man's bad dreams bear to his ideal life."

* Page 155. † Ibid., p. 155. ‡ Ibid., pp. 140, 142.

The causes of that reluctance to follow the theory of Evolution to its obvious and ultimate conclusions which this book illustrates are, as hinted above, twofold.

1. Presuming on an isolated supremacy in creation fostered by traditional beliefs, man tardily applied to his kind the investigation long extended to every creature beneath him, and the like pride of birth has hindered the admission of lineal connection between the beliefs of cultured races and those of savages. That in savage philosophy is the germ of the highest metaphysic and theology was a thing undreamt of; and the beliefs which antiquity transmitted were too much wrapped up with man's dearest hopes and desires to allure him into inquiry as to their origin and growth. Whilst the theistic philosopher, confronted by theories of automatism, frames his conception of an ego as an entity not depending for its existence on any play of physical or vital forces, the Romanist biologist argues that "whilst man's body was derived from pre-existing material, his soul was created by the direct action of the Almighty." These, with all other kindred theories of man as dual or tripartite, are but the other self of primitive thinking "writ large." 'Tis a difference of words, not of things. Banish the terms, and in their thought the lower and higher culture have met together, the fetichist and the spiritualist have kissed each other.

2. In that assumed antagonism between matter and spirit which is a legacy from the past. If when we use these terms—if when we talk of matter, of mind, of motion, of force—we employed them only as the x's and y's of the mathematician, as convenient symbols of that which cannot be known, this bugbear of materialism which drives men into opposite camps would disappear. Our only escape from it is in accepting that philosophy of idealism which supposes that our "knowledge of matter is restricted to those feelings of which we assume it to be the cause," and that, whatever it may appear to us, it is probably something altogether different. We shall not then speak of "laws of Nature" as entities, or, because a convenient name has been given to certain classes of phenomena, suppose that the name is the thing, or the cause of the effect observed.

To sum up. As a lucid exposition of a theory which nourishes the intellect and enthralls the imagination, this book is to be commended; as an attempt to engraft the spiritualist hypothesis, for such it really is, upon that theory, the book is to be condemned. Nor would its later chapters have been criticised here did they not represent a literature which is the outcome of minds profoundly affected by the results of modern research, and prepared to abandon many a cherished belief, but to whom the words addressed to the wealthy ruler apply, "One thing thou lackest."

NOTE.—In any future edition of his book Mr. Kirby should correct the popular but incorrect meaning of Nirvāna to which he gives currency. It is, according to Dr. Rhys Davids, neither a place of celestial repose, nor annihilation, but "the extinction of that sinful grasping condition of mind and heart, which would otherwise according to the great mystery of Karma, be the cause of renewed individual existence."—Rhys Davids's "Buddhism," pp. 111, 112.

A CHALLENGE FROM THE EARTH-FLATTENING SOCIETY.

By Richard A. Proctor.

Because I have just finished a series of papers giving some illustrations of the earth's rotundity, I have been invited by a Society called the Zetetic Society to discuss with Parallax the question whether the earth is flat or round. The invitation has been gravely presented to me, despite my oft-repeated statement that there is no such question for me or for any one who, having learned what are the known facts, has average power of reasoning about them. But I have no doubt my declining to accept this invitation, courteously enough advanced, will be described (if not actually regarded) by the Zetetists as evidence of weakness in the theory of the earth's rotundity. I am not greatly concerned on this point. I am amused, however, at the quaint reasoning of Parallax himself on a personal question. It is known that speaking of the book which he published somewhere about the year 1864 (it was then at least I first saw it, but it may really be older), I have expressed my doubts whether he is really sincere, however earnest his followers may be, in denying the earth's rotundity. He advances the singularly illogical objection that he has never questioned my sincerity and therefore I have no right to question his. As if, before one challenged what one believes to be false and wilfully false teaching, one were bound to wait till such a charge had been brought against oneself. Were a charge of insincerity brought against me, and based (as of course, to make it worth noticing at all, it must be based) on some acknowledged statements of mine, I should be prepared to answer the charge. That none such has been made by Parallax is *primâ facie* evidence that he knows of nothing I have ever said which could so be challenged. Now my charge of insincerity against him is based on definite passages in his book, and has never been met, except by vague denial of insincerity. Thus he states that with his eye close to the water level (still water) he saw through a telescope the whole structure of a bridge over the water, down to the very water, six miles away: but he has invented a law of perspective (it has no existence in nature, but *that* is nothing) explaining (what he knows very well) the fact that one can never see what he described. He states that out of fifty trials in which he fired a gun tied vertically, the bullet *twice* came back into the very muzzle of the gun: if a man, shown otherwise to be of unexceptionable veracity, told me this, I should feel sure he mistook a dream for reality: if I seemed to see it myself I should *know* it was a dream. He introduces quotations which seem to support his doctrine of a flat earth, but in every case a reference to the original shows that he stopped short at the very point where words were coming which would have been made the passage bear quite the other way. He quotes from an old number of the *Times* a passage in which the North Star is described as seen from a certain ship in latitude 23°, in such a way as to suggest the idea that this was south latitude. On turning to the passage I found that from the date of sailing and arrival of the ship it was clear (and must have been clear to him) that the ship was in north latitude. He refers to the motion of a bottle carried by currents through some 240° of longitude in the southern seas in such a way as to convey the idea that the bottle had gone the short way round, though on referring to the passage cited (in Captain Ross's book on the Antarctic Seas) it appears that he could not possibly have mistaken Captain Ross's clear statement that the bottle was carried the long way round. He speaks of latitudes in North Zealand in terms implying that they are much the same as latitudes in England, only southern instead of northern, though he cannot but be aware that they are very different. Lastly (to pass over a dozen or so of kindred cases) he has ever shown himself unwilling to touch on the obviously fatal objections to his theory (two or three of which I shall presently mention) though ready to discuss at any length those points in which he knew there was no particular difficulty.

From this evidence I deduced the conclusion that as Parallax is manifestly not wanting in intelligence or even in ability, he advocates a theory which he knows to be erroneous; for no intelligent person will bolster up a sound theory by false experiments, garbled extracts, and untrue statements, or be unwilling to examine into all such difficulties as even true theories commonly present.

And now, if it will be any comfort to the Zetetic Society or to believers in Parallax's theory of a flat earth or any modification of it yet presented to an amused world, I announce myself as perfectly ready to discuss the matter whensoever any member of the Zetetic school—

(1.) Has shown why, despite the enormously varying distance of the sun (while yet it is day) according to their theory, the sun does not vary correspondingly in apparent size.

(2.) Has explained why though according to their theory the sun never passes to such positions as to lie towards the south of east and west in New Zealand, Victoria, or Tasmania, he is seen, in summer mornings and evenings, far to the south of east and west.

(3.) Has shown why at the equator in spring and autumn the sun rises due east and sets due west, though according to their chart and account, it is really due north-east and due north-west at six a.m. and six p.m. respectively at the equator in spring and autumn.

And (4.) has assigned any possible positions to, say, the seven chief stars of Orion, consistent with the circumstance that these stars present precisely the same configuration when seen overhead at the equator, or low down towards the south from high northern latitudes, or low down towards the north from high southern latitudes, the last view showing the giant inverted, but the configuration of the star-group absolutely unaltered.

In order to ascertain to what extent aniline colours might be injurious to health, notice was, for some years, taken of the health of the *employés* of the aniline colour works at Hochst-on-the-Main, where 672 persons are employed. Reporting the result, the *Journal of Gas Lighting* says that it is known that nitro-benzol is poisonous, yet among the 24 men employed at Hochst, in the nitro-benzol house, during the last four years, symptoms of "nitro-benzolismus" appeared in only five cases. Aniline, also, is admittedly poisonous; and of the 29 men employed in the aniline house at Höchst there were 18 cases of specific aniline poisoning, none of which proved fatal. The workmen in the magenta house were always reddened with dye, even to the inside of the mouth, and some of the material must therefore have been swallowed; yet not a single case of specific ailment has occurred among them for eighteen years. Neither magenta nor its derivatives, when made without arsenic, can be considered in the least degree harmful. Naphthaline is observed to be deleterious only when in the form of hot vapour. On the whole, Dr. Grandhomme finds that the average mortality of the work-people was 4·2 per cent., which is a distinctly favourable result, and should go far to dispel any lingering dread of coal-tar colours, on the ground of their containing poison.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

ORDNANCE MAP MEASUREMENTS.

[1025]—I see "E. H. O." is not a surveyor, but his letter opens up an interesting question.

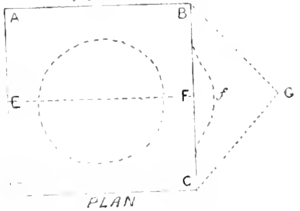
It is absolutely necessary in surveying hilly land to reduce all measurements to a horizontal datum. Land in such situations is always bought and sold in accordance with that rule. Thus, an acre of land on a hillside is really greater than an acre in the level, although the additional yards it may contain may be stated as the unavailable portion.

Let us briefly consider a case.

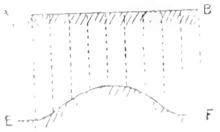
"E. H. O." buys a level field surrounded by a fence in the shape of a perfect square whose side is 10 chains. The area of the field is 10 acres. Through a convulsion of nature a large mound is thrown up in the centre, two or three hundred feet in height, leaving the fences undisturbed.

The area of the surface now contained is obviously greater than before, although a surveyor would take no notice of this fact, but would make the area 10 acres, as originally.

The necessity for adopting this system of surveying will be seen on considering the diagram.



PLAN



SECTIONS

A B C D is a square whose side is 10 chains in length; the mound is shown by dotted lines in the centre. On measuring the line E F along the surface of the ground its length is found to be greater than 10 chains, and this length set off from E would extend to F, distorting the fence which we know has not changed its position, and bringing it nearer the point G, which we also know is not the case. The necessity for reducing the measurements to a horizontal datum is at once seen.

I have stated that the additional area enclosed is unavailable; if we examine the sections A B, E F this is obvious. "E. H. O." cannot put up more houses, cannot grow more trees, nay, he cannot get more corn off his field with the additional superficial area, than he could when his field was flat. He would not care to pay for having the luxury of the hypotenuse of a triangle under his drawing-room floor instead of a level line, neither would he thank any one for the present of a few acres on the face of a cliff. The ordnance survey is quite right; the surveyors do, as the astronomers do, take the mean circumference of the earth. Astronomers do not take the measurements of the circumference of the earth, up and down the mountain sides. The levels and contour lines on the plans show the hills.

Chalk.

POSTAGE STAMP FORGERIES.

[1026]—I am enabled to inform you that, in consequence of the action of the press, combined with the refusal of the person referred to in the following letter to deal with forged stamps in any way, and the subjoined note from myself to the Postmaster-General, the postal authorities have put in motion the Act of Parliament of 1840, whereby the possession of, or attempt to sell or dispose, by any means, of any forged stamp, or representation of a stamp, or the means for producing a forged stamp, is constituted a felony, the penalty for which is five to twenty years' penal servitude.

Philatelists may now congratulate themselves upon being protected from being duped by "facsimiles" or "copies"—which simply mean forgeries—of stamps of any description. They have the simple, immediate remedy of communicating the brief facts of their case, postage free, to "the Secretary's Office, Post-office, London," in the event of any sale, or offer of sale of any kind of forged stamp.

Nemesis.

[Copy of letter referred to above.]

To the Right. Hon. H. Fawcett, M.P. Nov. 2, 1883.

Sir,—I have the honour to enclose for your inspection a forged postage stamp which has been offered for sale as being a genuine "Hong Kong" 16 c. stamp. As there are thousands of persons who would be glad to purchase this stamp, believing it to be a genuine British Colonial stamp, especially as it purports to be authenticated by the Post-Office obliterating stamp, may I ask if you, as the head of the postal system, are disposed to afford any official aid to prevent the sale of these forgeries? and thereby guard thousands of intelligent young collectors of stamps from further fraud and imposition. As some evidence of the extent of this trade in postal and fiscal forgeries, I can inform you that one dealer in stamps alone* has now in his possession above 10,000 forged stamps, chiefly British, many bearing the official post-mark. These forgeries have been collected at great cost, and to give some idea of this cost, if these forgeries were again to be sold to stamp purchasers they would readily sell for at least £1,500!—a large sum for the public to be victimised out of.—Respectfully waiting the honour of your early reply, &c.,

Nemesis.

A STRANGE PHENOMENON—JUPITER'S SATELLITES.

[1027]—The letter (1019) of "Major ab Adversis," on p. 322, suggests to me to say that I myself received yesterday a letter dated October 31, from Kamptee, in the Madras Presidency, from which I extract the following:—"Extraordinary after-glow very nearly every evening. After sunset and after the sky got dark, it gradually reassumes the most brilliant roseate hues, which last some time. Also sun used to be *green* in the morning. Natives say sickness, famine, end of the world, and all sorts of things. Have you had anything like it?" Now, it is just because we have had something like this abnormal after-glow—in fact, the identical phenomenon—here in Sussex within the last two or three weeks that I trouble you with this communication. I first saw it after sunset on the night of November 8, when it assumed the appearance of an auroral glow over that part of the horizon below which the sun must have been situated. Its brilliance was so remarkable that a friend (Dr. Trentler, of Fletching), who had been with me in my observatory, and had left, returned on purpose to invite my attention to what he (a skilled meteorologist) regarded as a beautiful display of the Aurora. The whole of the western sky was ablaze with the most vivid crimson glow; albeit the sun had set for more than an hour and a half. A repetition of this striking phenomenon on the succeeding evening (the 9th) enabled me, however, to trace it definitely to the sun. I have not seen it since.

It needs a certain amount of temerity to differ with any one possessing such intimate familiarity with astronomical facts as the Editor of Knowledge; but I would venture to remark, in connection with his footnote to Letter 1024 (p. 323), that, while fully agreeing with him as to the instability of Jupiter's apparent surface, I do not think that we need go beyond the inaccuracy of

* We have omitted the name for sufficient reasons.

Damoiseau's "Tables of Jupiter's Satellites" for an explanation of the discordance between the predicted and observed times of their phenomena. Since the publication of those tables—forty-seven years ago—ample materials have accumulated for the calculation of fresh ones, if the Government would only find the comparatively small sum needful for that purpose. They might begin by granting the amount annually wasted on the wretched little quack "Committee on Solar Physics," at South Kensington, for this laudable purpose. WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield, Nov. 23, 1883.

"STRANGE PHENOMENON."

[1028]—In your issue of Nov. 23rd, I notice "Major ab Adversis" gives an extract from a private letter dated Kurrachee, Oct. 14th, concerning a brilliant glow after sunset. Perhaps in connection with this the following, received by the last Cape Mail from a friend residing in the Karoo district, near Graaff Reinet, may also be of interest to your readers.

"Oct. 21st.—Many of us out here are much interested in a very peculiar light visible in the west nearly every evening about an hour after sunset. It lasts until quite dusk, and throws a sort of lurid glare over everything, and the sky is angrily red. I have not seen anything about it in the papers, but the people were very full of it in Graaff Reinet. It is now about a month since we first noticed it." M. CAREY-HOBSON.

BIRTH AND GROWTH OF MYTH.

[1029]—In Vol. IV., No. 103, of KNOWLEDGE, Mr. E. Clodd, in his seventeenth paper on this subject, quotes the tale of Llewellyn and his faithful hound Gellert, which he classes as a fabulous legend; though, if we may believe an anecdote related by Ferishta, the Persian historian, who lived in the sixteenth and seventeenth centuries, and chronicled the events of the reign of Akbar, "the greatest of the great Moguls" (who died in 1605, and of some of his successors) it had its counterpart in Asia in those times.

In Ferishta's work, translated into English by Dow about a century ago, we find an account of the early life and adventures of Nur Mehal, who became the wife of Akbar's son Jehangir, and was the aunt of Mumtaz Mehal, to whose memory the Taj at Agra was afterwards erected by her husband, Shah Jehan, the son of Jehangir.

The tale runs as follows:—Chiaja Aiass, the father of Nur Mehal, was a native of Western Tartary, who belonged to a noble family fallen into decay. He and his wife agreed to seek their fortune in India, they having relations high in power at Akbar's Court; their whole wealth when they started appears to have been a sorry steed, on which the wife rode, as she was not in a state to endure fatigue. During their journey they were forced to subsist on charity; and after a time, to complete their distress, a daughter was born to them. The mother was very weak, and the father much exhausted with privations, consequently they saw no alternative but to expose their infant on the highway and leave it; they therefore placed her beneath a tree and went on their way. But after they had proceeded a short distance, the mother's heart pined for her child; she could no longer contain herself, and wept bitterly at the thought that she had been so cruel as to forsake it. Chiaja Aiass on this returned to the spot where they had left the baby, with the intention of restoring the infant to its mother, and, as the story goes, he found a black snake had coiled itself round the child, and on his calling out, the animal glided away; that he took up the child, which was unharmed, and that the family then proceeded by slow marches to Lahore, where Akbar at that time was holding his Court." Can this tale have been the foundation of the story of Llewellyn and Gellert? and the latter be but the European version of an incident which occurred in the East? COSMOPOLITAN.

[PROBLEM.—To find in the above story the hound Gellert.—R. P.]

WEATHER FORECASTS.

[1030]—I am very far from wishing to anticipate anything that Mr. Browning may have to tell us when he resumes the papers on weather forecasts begun in your number of KNOWLEDGE of October 12, but there is one point I should like to bring under the notice of your readers, who may be interested in this use of the spectroscope and are, like myself, observers—and the sooner this is done, I think, the better. My question is whether we cannot agree upon some general method of observation.

There are many conditions to be noted, and many things to be duly weighed and considered, in arriving at the mental comparison to be made by numbers ranging up to 5, as suggested in Mr. Rand-Capron's pamphlet.

I myself have drawn up, and am using daily, a form which contains no less than twelve columns, of which I send you a copy, and possibly there may be other things of importance which I have omitted.

At first this may seem complicated, but I am convinced that every one of these columns is of importance, the variations shown are very curious and interesting, and although I am, as yet, unable to correctly interpret their meaning in every case, still I find them often very helpful and suggestive. I can note them all now with ease and rapidity, and I do not find that the whole observation is appreciably lengthened by giving attention to their several points.

I should be very glad to hear what others are doing, and under what form they are recording their observations.

Although I make my observations at 9 a.m. daily, I am convinced that one observation a day is not nearly sufficient, and that the spectroscope may be used many times a day with advantage, the changes in the relative values of the columns being often very rapid, and the instrument quite as susceptible of recording passing atmospheric conditions as the aneroid barometer.

JOHN T. HARDING.

P.S.—On Friday, November 9, I noted an extremely sharp and well defined fine line, a little to the right (*i.e.*, towards the blue end) of the D lines. I have failed to exactly identify it. I wonder whether any other observers also noted it on that day. I have looked for it since and failed to discover it, at all events in anything like the intensity it showed on that day, although in other respects, the spectrum has been much the same.

Date.	Rainband Lines. 0, 1, 2.	Rainband shading. 0, 1, 2, 3.	Extent in height. 0, 1, 2, 3, 4.	Spectrum generally, whether Clear, Moderate, or Faint.	Earth Bands, Ditto.	Other Lines, if any remarkably Prominent.	Sky, whether Clear, Broken, Overcast, or Rain.	Total Value of the Observations. 0, 1, 2, 3, 4, 5.	Rainfall.	Whether the Forecast was True.	Approximately True, or False.

STORM GLASS.

[1031]—E. Brown (No. 1013) does not hit the point of the inquiry which was made recently in your useful journal. The storm glass asked about was a chemical one, such as are to be found attached to the Fitzroy barometer.

I have not the number of KNOWLEDGE by me which contains the query, but I noted at the time that the materials were the same as I used above twenty years ago with success. But they require careful manipulation, or they will not succeed, as the querist found. I have made several recently in two-ounce bottles. Some succeed, others do not.

I have had most success when I have used distilled water for the two salts, and used a less quantity of water than was mentioned by the querist. Then carefully pour in the solution of camphor, and cork. Let the bottle remain still to allow a slow combination, and the result ought to be that the salts are thrown down and the clear solution floats over them. If the upper portion remains clear it betokens fine weather. If crystals sprout up into the clear it betokens, with a falling barometer, rain or snow, or with a high barometer, wind and storm. Such, at least, is the result of my observation as to the barometer recommended by E. Brown. I have had one in use for years, but it requires fresh water occasionally to make up for evaporation. I also put some water into the Florence flask before inverting it in the pickle-jar, which, of course, must have less water in than E. Brown directs. But this is not a storm glass properly so called, but rather a makeshift barometer, and on the same principles.

I cannot explain the action of the true storm glass, unless on the supposition of magnetism, as it is carefully exempted from atmospheric pressure. H.

Pershore.

P.S.—On referring again to "E. Brown's" communication, I note that he recommends the oil-flask to be surrounded by a piece of cork so as to be air-tight. If so, how could the atmospheric pressure force up water into the flask? He ought to have said, Place

two or three pieces of cork between the neck of the pickle-bottle and the flask, so as to allow the air to pass freely. If this be not minded the water will keep its old level always.

LARGE v. SMALL WHEELS.

[1032]—In letter 985, p. 277, a correspondent (W. W. D.) states that diminishing the diameter of the wheels, supposing the height to remain the same, will increase the liability of the tricycle to overturn. Surely this is a mistake. The liability to overturn depends (if the height of the seat remain constant) not on the height of the wheels, but on the distance between them.

A. M. B.

DULL HEARING AND THE MICROPHONE.

[1033]—Is there any adaptation of the microphone or other instrument which will gather and convey sound to persons slightly dull of hearing, for use at public lectures, or meetings, and in the social or family circle, but not in the nature of ear-trumpets or tubes with mouth and ear-pieces of large size, and which are dangerous if used in a crowd?

If a sound receiver, fixed say in the breast opening of the vest, could be connected with a microphone, the sound being increased in volume passing through, connecting again by wire or thin gutta-percha or indiarubber tubing, with one or both openings of the ear, this would be a boon to thousands who, from thickened drums, or displacement of the small bones of the inner ear, or other slight disarrangement, are just too dull of hearing to catch sounds uttered in ordinary conversational tone. If this is possible, a small saucer-shaped receiver might be placed on the chest, the microphone being in an inside coat-pocket, the connection from receiver to microphone passing through the arm-hole of vest, wire or tubing again connecting with the microphone, conveying the sound, increased in volume, to the ear. The connections could readily be run between the clothing, and passing between the neck-band of the shirt and a buttoned-on collar, be almost or quite out of sight. The sound conveyers to the ears could be easily kept in place by thin spring wire passing at the back of the head, as often used to secure spectacles.

Te Whiti, New Zealand.

LETTERS RECEIVED AND SHORT ANSWERS.

J. C. P. The "Universe of Stars" is a more scientific work than any of the others you name; "Other Worlds" the more complete of the rest,—which treat of general subjects. An *atmosphere* not necessary for light; rays falling on any substance make it visible.—F. S. L. Thanks for explanation; but fear readers would say they knew.—A. C. Rodgers. Nay, I simply defended Professor Fiske, Vega, and the rest from the tide of your contempt, and showed what might be said on their side,—I may say on our side Or rather we are in the *midst*, not on either side: in the midst of darkness visible (symbolization, again, my dear sir). On one side are those who think they know what God is and wills, on the other side those who think and say they know that there is no God that is and wills; in the midst are they who feel there is a Power at the back of all we know, but do not pretend to know its natnre, plans, or purposes. Your dogmatic denials are as outside our plan as dogmatic assertions of belief. For the rest you find indignation and wrath in sentences free from either. You had expressed contempt and rancour for us who take the middle track, but we had and have no rancour or contempt for you on one side, or for the other Gnostics who are over the way. We simply doubt whether you know all you think you know. F. W. W. My *dear* sir, how could I possibly answer your question without considering first all discoveries made with the microscope (say ten thick vols. imp. 8vo), then all those made with the telescope (say same space), and then entering on a careful comparison—say ten vols. more, and three lifetimes. I would be glad to do this if I could spare the time and possessed the requisite skill: but as matters are I must decline. To fully deal with the use of the microscope to botanist (2 vols.) anatomist (3 vols.), and physiologist (3 vols.) would take less time and space; but even for that these columns are not quite large enough.—D. Alas yes, the man in the moon is inverted in the southern hemisphere; but *per contra* the telescope which inverts him here puts him right side up there.—J. K. F. Thanks.—Perturbed. You have no reason to be perturbed by Professor Cayley's address and the idea of a fourth dimension in space. Would the idea disturb you that as yet we cannot conceive the square root of a leg of mutton?—H. J. W. Do not know the names you mention; but know that very good instruments of moderate price often so procurable.—W. Fraser. Fear can give no satisfactory opinion about the suggested motive power of tricycles.—Thorough. I agree with you as to the desirability of stamping out inherited and inheritable tendencies to crime, if it could be done; but not by execution. Why not simply remove from their fellow-men?—More Light. I have no chance of investigating the system just now.—J. Edwards. Thanks; but meteor you saw not unusual, and your observation gives no evidence available for determining its real path in our air. —R. P. J. The subject of poker across fire was fully considered long ago. I can find no possible scientific reason for it; and it is well known it began by way of making the "sign of the Cross" over the fire. Sunlight seems so obviously to dull firelight that the mistake in that case is natural enough. —M. G. I do not myself think the sun will ever be an abode of life. Saturn very obviously visible to the naked eye just now near Aldebaran,—being brighter than that first magnitude star.—W. C. M. Thanks for clever and amusing lines. Would print them here if I dared. But a host of misunderstanding ones would fall on me forthwith.—H. B. Heath. If two persons leave Greenwich at noon exactly, on Monday, one east the other west, and travelling as quickly as thought reach longitude 180° from Greenwich, one can draw no distinction between the day for each. At noon in latitude 0°, Monday is just beginning at a point a hair's breadth west of longitude 180°, and just ending at a point a hair's breadth east of that longitude. But at that precise longitude you can say neither one thing nor the other. If a traveller having gone west in an instant to a point just short of 180° were then to take a step over that longitude, he would theoretically pass from the beginning of Monday to the end of Monday or the beginning of Tuesday, but a step back would take him to the beginning of Monday again. M'chester. I regret that I have no personal acquaintance with Dr. S.—R. A. Law. Thanks. The Boston yellow sun was commented on in these columns, I think.—W. H. Spencer. Thanks for picture showing seven sunspots visible March 30, 1870, to the naked eye (separately visible, if I understand you aright).—Merlin notes that two sunspots were visible to the naked eye on July 21 last.—H. K. Harris. The auroral gleam often extends as far as due west, and its centre is always considerably to the west of north.—C. H. J. We could not just now find room for the suggested botanical papers. —J. Dyer shows convincingly that the flat earth theory would necessitate two days and two nights, each about six hours long, in every twenty-four hours.—H. Rolfe. Certainly more people have died within the last 800 years than are living now.—H. C. Standage. Can recognise no such claim, the MS. having been sent unasked.—Albion. Laws of spelling inscrutable. As you say, why should some of those words be spelled with e, some without? They would all be spelled with e's if we had a constant rule.—C. A. Ede. Many thanks.—J. C. Kernshaw. Thanks, but that was not a lunar rainbow, though rainbow colours were shown. A lunar rainbow can no more encircle the moon, than an ordinary rainbow can encircle the sun.—Jas. Brown. The air too thin to be warmed appreciably.—H. Seward. The paragraph and paradox simple bosh, as you suggest. —Michael Murphy. Arrah, be aisy.

Our Whist Column.

By "Five of Clubs."

Whist Ending p. 311. Correct solutions of both 1 and 2 by J. H. D. L., K. R. M., Long Trump, Bumper, J. N. Harrogate, and M. Wilson. Solutions of 2 by C. N. W., No Whist Player, (Sad)! A. M. Chambers, R. Carthwaite, J. Hargrade, M. Pennington, Veritas, Crafty One, J. N. Mumbles, K. K., and L. J. N., correct.

Several correspondents answer 1, which is really the easier question, incorrectly, though solving 2 correctly. Of course, to win, *Z* must lead the long Spade; but if *A* trumps and *Y* overtrumps, or if *A* throws a Club and *Y* trumps, *A B* can win every trick if they play correctly. A. M. Chambers, M. Pennington, and others make *A* throw a Club, *Y* trumps and *B* overtrumps; then *B* leads a Club and *A*, winning the trick, leads a Club. This would be throwing the game away. If *A* lead a trump through *Y*'s minor tenace, *B* wins all the remaining tricks. *Y* can only win by throwing his Club to *Z*'s lead of the long Spade. He can only then be led through once, whereas for *A B* to win every trick *Y* must be led through twice, since he holds 2nd, 4th, and 6th best trumps.

Next week the game closing with this pretty position will be given in full.

J. W.—Yes: a player is entitled to look at the last trick at any time during the play of the current trick. The idea that he cannot do so until all four cards have been played, though sometimes suggested, is quite mistaken. The last trick is looked at (but by inattention of players only) to guide the play in the current trick: at least this is so in nine cases out of ten.

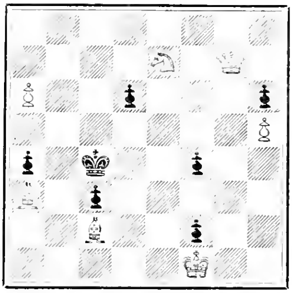
Our Chess Column.

By Mephisto.

PROBLEM No. 108.

By B. G. Laws.

Black.



White.

White to play and mate in three moves.

The following game, taken from the *Times Democrat*, was one of three games contested by Herr Zukertort, at New York, against Mr. Jas. McConnell, of New Orleans. The master won the remaining two games.

French Defence.

White. Zukertort.	Black. McConnell.	White. Zukertort.	Black. McConnell.
1. P to K4	P to K3	12. P to B4	Kt to QB3
2. P to Q4	P to Q4	13. R to Kt sq. (c)	B to B4
3. QKt to B3	B to Kt5 (a)	14. P takes P	Kt to KKt6
4. P takes P	B tks Kt (ch)	15. Q to Q sq.	Kt tks B (ch)
5. P takes B	P takes P	16. Q takes Kt	B takes R
6. Kt to B3	B to Kt5	17. P takes Kt	P takes P
7. B to K2	Kt to KB3	18. B to R3	R to K sq.
8. Castles (b)	Kt to K5	19. Q to B4	B to K5
9. Q to Q3	Castles	20. Kt to K5 (d)	R takes Kt
10. P to B4	P to QB3	21. P takes R	B to Q6
11. P takes P	P takes P	22. Q to B3	B takes R

And White resigned (e).

NOTES.

(a) All authorities agree in condemning this sally of the Bishop and the capture of the Knight. Mr. McConnell, however, prefers the text move to the usual 3. KKt to B3.

(b) 8. B to R3 looks plausible, and seems to hamper Black's movements considerably.

(c) A slip, of which Black takes full advantage.

(d) Unavailing.

(e) Black must now win another piece, *e.g.*, 23. K takes B, Q to Q8 (ch). 24. Q to K sq., Q to Q6 (ch), &c.

Correction.—In Problem 107, there should be a Black P on KKt2.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. T. Law.—Problems received with thanks. Will receive due attention.

Donna.—107 correctly solved, but please see correction above. You have the right first moves to 105 and 106.

Query.—Replied by post last week.

N. T. Angell *v.* G. Woodcock.

P. G. R.—See last week's number.

Clarence.—Highly flattered by your encouraging remarks. Problem 33, of Pearson's collection, cannot be solved by 1. Q to R6, Kt takes Q. 2. Kt takes Kt, as the R checks on K2; nor can you do No. 49 as proposed by 1. Kt to B3, B to Kt2. 2. Q takes B. After 2. P takes Kt there is no mate. You are right in 107.

A. Conrad Smart.—Notation indistinct. No. 106 after 1. P to B5. 2. Q to Kt8 (ch), K to B4. There is no mate if 3. Q takes P, Kt takes Q. No. 105, if 1. P takes Q. 2. P takes Kt (Q), R to B4, and again there is no mate.

Herbert W. Feather.—Problem received with thanks.

Correct Solutions Received.—Pearson's Problem, No. 33: G. Woodcock, H. A. N., Berrow. No. 49: G. Woodcock. No. 105: G. Woodcock, Rev. W. Anderson, H. A. N., Clarence, A. Schmucke, W., Berrow, S. B. B., Stettin, M. T. Hooton, G. Johnson, P. G. R., No. 106: Herbert W. Feather, John, W., Clarence, Rev. W. Anderson, H. A. N., G. Woodcock, M. T. Hooton, Stettin, P. G. R. No. 107: G. Woodcock, H. A. N., Rev. W. Anderson, Clarence, W., A. Schmucke, John, Herbert W. Feather, Berrow, S. B. B., Stetttin, M. T. Hooton.

For the guidance of correspondents we make known the following rules:—

1. In our replies we give the full and exact signature of a communication.
2. Correspondents may adopt any signature they please.
3. It is desirable that every communication should contain the name and address of the writer.

Contents of No. 108.

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PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DEC. 7, 1883.

Contents of No. 110.

THE EXTRAORDINARY SUNSETS.

By A. C. Ranyard.

THE last number of Knowledge contains an extract from a letter received from a resident at Graaff Reinet, in South Africa, mentioning that a brilliant glow in the sky after sunset had for a month past attracted the attention of the inhabitants. Similar letters have been received from places in the northern hemisphere as distant as Ceylon on the one hand and Trinidad on the other; and within the last month sunset and sunrise tints of more than usual splendour have been observed in England and over the continent of Europe.

Professor Piazzi Smyth has endeavoured to account for the sunset and sunrise phenomena observed in India, by supposing that there must have been an unusual amount of aqueous vapour in the higher atmosphere, due to exceptional meteorological conditions such as precede a great fall of rain. But similar meteorological conditions seldom exist over so wide an area as that embraced between the Cape, India, and the West Indian Islands, and exceptional meteorological conditions seldom remain with comparatively little change for more than two months. I am rather inclined to attribute to a cosmical origin the glorious phenomena which have been observed over a whole hemisphere, and possibly all round the globe. Before explaining my theory, I will give a short *résumé* of the phenomena observed, with some of the observations I have collected on the subject.

Dr. J. Arnold, writing to the *Times* of October 9, makes the following quotation from the letter of a friend in the Island of Trinidad:—"Last Sunday (September 2), about five o'clock, the sun looked like a blue globe . . . . and after dark we thought that there was a fire in the town, from the bright redness of the heavens." Mr. Arnold adds, "All my correspondents agree as to the blue colour of the sun." Three days afterwards a cyclone swept over Martinique.

In *Nature* of Oct. 11 a letter is printed from Mr. W. R. Manley, dated Ongole, India, Sept. 14, in which he says:—"My attention was first called to the matter on Sept. 10. On looking out I saw that the sun, which was somewhat dimmed by a haze, had a decidedly greenish-blue tinge. The same thing was observed on the 11th and 12th, both morning and evening; but my observations were confined to the evenings. About four o'clock (at least I did not notice it earlier) an indistinct bluish tinge appeared in the light This gradually passed into a greenish colour, and this in turn became tinged with yellow as the sun approached the horizon. After the sun was down, light yellow orange and red appeared in the west, a very deep red remaining for more than an hour after sunset; whereas under ordinary conditions, all traces of colour leave the sky in this latitude within half-an-hour after the sun disappears. On the evening of the 13th the sun appeared to be perfectly clear, but after it was below the horizon the western sky became brilliantly illuminated with yellow orange and red in the order I have mentioned. These sank one after the other, leaving at last an arc of brilliant red along the west, the inner portion of the segment contained by the arc being composed of orange. This disappeared in turn, and the whole western sky became yellow again without any distinct outlines, and this gradually deepened into red, which remained for an hour or more after sunset. The latter phenomenon was not unlike an ordinary sunset, except in brightness and duration . . . . there was apparently nothing unusual in the state of the weather at the time."

Since the beginning of September, numerous communications have been received from all parts of India giving accounts of the remarkable sunset tints, and for the last two months similar sunsets have been observed in Europe.* A friend, writing to me from Nice on Nov. 15, says:—"We have had extraordinarily beautiful sunsets for the last month, with a coloured twilight lasting much longer than usual." The prolonged afterglow has been noticed in England. Captain Noble, in the last number of Knowledge, says that on Nov. 8 "the whole of the western sky was ablaze with the most vivid crimson glow; albeit, the sun had set for an hour and a half;" and Mr. W. T. Lynn, formerly of the Greenwich Observatory, informs me that there is a very striking increase in the duration of the morning as well of the evening twilight. It is therefore evident that there must be finely-divided particles of matter suspended at a considerably greater height than usual in the atmosphere; and the question arises, Is this matter condensed aqueous vapour? Is it volcanic dust from the great eruption of Krakatoa in the Malay Archipelago, which occurred at the end of August? Or does the dust come from outer space?

As to the first hypothesis. The meteorological conditions at the earth's surface have not been strikingly uniform over the area within which the remarkable sunsets have been observed; and there has been no widespread and exceptionally great downpour of rain such as might have been expected if the amount of aqueous vapour in the atmosphere over a whole hemisphere of the earth had been much larger than usual.

The date of the great eruption of Krakatoa, as compared with the date of the earliest observations of the green sun in India, would seem at first sight to favour the hypothesis that the colours must be due to light dispersed by volcanic ashes or volcanic dust borne away by the trade winds.

Those who have watched an eruption of Etna or Vesuvius know how the volcanic vapours are carried to a certain altitude above the crater, where they spread out in a horizontal cloud, which, under ordinary circumstances, does not attain a very great altitude. It is possible to conceive that such a cloud laden with dust might, in the

* I have searched a file of American newspapers, and the pages of *Science*, a periodical published at Boston, but have not succeeded in finding any reference to red sunsets in America. I should be glad to know whether they have been seen in the United States and China.

neighbourhood of the equator, be carried upward by the heated air which gives rise to the trade winds. But in the northern hemisphere the trade winds blow in a north-easterly direction, and this theory will not account for the carriage of dust to India, which lies to the north-west of Java; or to South Africa, which lies in a south-westerly direction. The fine dust of the Sahara, carried upward by exceptionally strong sirocco winds, occasionally reaches Rome and Florence, but all traces of it are lost as far north as Paris and London. It seems, therefore, very improbable that terrestrial dust should be carried upward by the wind and distributed over a whole hemisphere. It may be suggested that dust was on this occasion projected by the volcanic forces to a far greater altitude than the altitude reached by the dust from the Sahara. But dust projected with great velocity would be rapidly stopped by the resistance of the atmosphere, and would not, unless borne away by the wind, be carried as far as stones and large masses of scoriæ. It will hardly be suggested that the volcanic cloud over Krakatoa was carried upwards by the heat of the eruption, and spread outwards over a whole hemisphere, drifting against the prevailing winds to India and South Africa. But the volcanic theory is completely negatived by the observation of the blue sun setting in the fiery heavens as seen from Trinidad (near to the centre of the opposite hemisphere from the Krakatoa eruption) on the 2nd of September, for it cannot be supposed that the volcanic matter was carried half round the earth in the period of seven days which elapsed between Sunday, the 26th of August, when the Java eruption began, and Sunday the 2nd of September, when the blue sun was seen setting at Trinidad.

There remains the not improbable supposition that the earth has encountered a cloud of dust in space. In a paper published in the *Monthly Notices* for January, 1879, I have collected a series of observations which show that meteoric dust is continually being deposited on the earth's surface.

To account for the simultaneous phenomena observed in India and the West Indian islands, it is necessary to suppose that just before Sept. 2 the earth passed through a region of space more than ordinarily rich in the dust which we know is so widely distributed in space.

If the dust-laden region was so large that the earth occupied many hours in passing through it, we may expect to find that the phenomena caused by the presence of dust in the higher atmosphere have been observed over more than a hemisphere of the earth's surface. We may also learn something as to the time which small particles of dust occupy in sinking to the earth from the higher regions of the atmosphere, where they are first brought to rest. Possibly months, or even years, may be occupied by the finer particles in the process of sinking to the ground, for small particles of dust are probably carried upwards by convection currents in the daytime and sink again during the night. Prof. C. A. Young has shown that threads from a gossamer spider, attached to a stick, float upwards when exposed to the sun, while they sink when the stick is removed into the shade. Such small bodies, when exposed to the sun, seem to be involved in a film of heated air, which is sufficient to raise them, and will even raise the body of the gossamer spider as well as his web in the summer air.

It is well known that a fall of snow brings down quantities of meteoric particles, and it will be a matter of interest to observe whether the first fall of snow greatly affects the red sunset phenomena. Judging from the duration of the after-glow, it seems probable that much of the dust may still be above the region of cloud formation.* No doubt the larger particles fell in the first few weeks, for the blue appearance of the sun when near the horizon, as seen through the clear air of the tropics, has passed away. I imagine that the whole of the phenomena observed may be accounted for by the mere presence in the upper atmosphere of a larger amount of dust than is ordinarily suspended there. It is known that water in which fine dust is suspended assumes a beautiful blue colour, and small particles suspended in the air probably produce a similar effect. We are perfectly familiar with the blue colour of the dispersed light from the heavens, and if the amount of dispersed light were greatly increased, it is only to be expected that the colour of the dispersed light would sensibly affect the colour of the more intense transmitted light.

The green colour afterwards seen when the sun was close to the horizon is, of course, easily accounted for by a combination of the ordinary absorption of the blue end of the spectrum with the absorption of the red end producing the blue colour, so that only the green or middle part of the spectrum was left. The red and orange tints of the after glow would be caused in the same manner as the ordinary sunset tints, only being exaggerated by the longer course of the rays through the atmosphere.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXIV.

SINCE the publication of my last paper, I have learned the proper name of the Swiss compound there described as *fondevin*, according to my recollection of its pronunciation in Switzerland. In an old edition of Mrs. Rundell's "Domestic Cookery," it is described as "*fondu.*" A similar dish is described in that useful book "Cre-Fydd's Family Fare," under the name of "*Cheese Soufflé* or *Fondu.*" I had looked for it in more pretentious works, especially in the most pretentious and the most disappointing one I have yet been tempted to purchase, viz., the 27th edition of Francatelli's "Modern Cook," a work which I cannot recommend to anybody who has less than £20,000 a year and a corresponding luxury of liver.

Amidst all the culinary monstrosities of these "high-class" manuals, I fail to find anything concerning the cookery of cheese that is worth the attention of my readers. Francatelli has, under the name of "Eggs à la Swisse," a sort of *fondu*, but decidedly inferior to the common *fondu* of the humble Swiss osteria, as he lays the eggs upon slices of cheese, and prescribes especially that the yolks shall not be broken; omits the milk, but substitutes (for high-class extravagance' sake, I suppose) "a gill of double cream," to be poured over the top. Thus the cheese is not intermingled with the egg, lest it should spoil the appearance of the unbroken yolks, its casein is made leathery instead of being dissolved, and the substitution of six-penny worth of double cream for a halfpenny worth of milk supplies the high-class victim with fivepence half-penny worth of biliary derangement.

In Gouffe's "Royal Cookery Book" (the *Household Edition* of which contains a great deal that is really useful to an English housewife) I find a better recipe under the name of "*Cheese soufflés.*" He says: "Put $2\frac{1}{4}$ oz. of flour in a stewpan, with $1\frac{1}{2}$ pint of milk; season with salt and

* The sediment from water derived from the first fall of snow which occurs this year should be examined, to see whether it is particularly rich in particles of meteoric iron.

pepper; stew over the fire till boiling, and should there be any lumps, strain the *soufflé* paste through a tammy cloth; add 7 oz. of grated Parmesan cheese, and 7 yolks of eggs; whip the whites till they are firm, and add them to the mixture; fill some paper cases with it, and bake in the oven for fifteen minutes."

Cre-Fydd says:—"Grate six ounces of rich cheese (Parmesan is the best); put it into an enamelled saucepan, with a teaspoonful of flour of mustard, a saltspoonful of white pepper, a grain of cayenne, the sixth part of a nutmeg, grated, two ounces of butter, two tablespoonfuls of baked flour, and a gill of new milk; stir it over slow fire till it becomes like smooth, thick cream (but it must not boil); add the well-beaten yolks of six eggs, beat for ten minutes, then add the whites of the eggs beaten to a stiff froth; put the mixture into a tin or a cardboard mould, and bake in a quick oven for twenty minutes. Serve immediately."

Here is a true cookery of cheese by solution, and the result is an excellent dish. But there is some unnecessary complication and kitchen pedantry involved. The following is my own simplified recipe:—

Take ¼ lb. of grated cheese; add it to a gill of milk in which is dissolved as much powdered *bicarbonate of potash* as will stand upon a threepenny piece; mustard, pepper, &c., as prescribed above by Cre-Fydd.* Heat this carefully until the cheese is completely dissolved. Then beat up three eggs, yolk and whites together, and add them to this solution of cheese, stirring the whole. Now take a shallow metal or earthenware dish or tray that will bear heating; put a little butter on this, and heat the butter till it frizzles. Then pour the mixture into this, and bake or fry it until it is nearly solidified.

A cheaper dish may be made by increasing the proportion of cheese—say, six to eight ounces to three eggs, or only one egg to ¼ lb. of cheese for a hard-working man with powerful digestion.

The chief difficulty in preparing this dish conveniently is that of obtaining suitable vessels for the final frying or baking, as each portion should be poured into, and fried or baked in, a separate dish, so that each may, as in Switzerland, have his own *fondu* complete, and eat it from the dish as it comes from the fire. As demand creates supply, our ironmongers, &c., will soon learn to meet this demand if it arises. I am about writing to Messrs. Griffiths & Browett, of Birmingham, large manufacturers of what is technically called "hollow ware"—*i.e.*, vessels of all kinds knocked up from a single piece of metal without any soldering, and have little doubt that they will speedily produce suitable *fondu* dishes according to my specification, and supply them to the shopkeepers.

The bicarbonate of potash is an original novelty that will possibly alarm some of my non-chemical readers. I advocate its use for two reasons. First, it effects a better solution of the casein by neutralising the free lactic acid that inevitably exists in milk supplied to towns, and any free acid that may remain in the cheese. At a farm-house where the milk is just drawn from the cow it is unnecessary for this purpose, as such new milk is itself slightly alkaline. My second reason is physiological, and of greater weight. Salts of potash are necessary constituents of human food. They exist in all kinds of wholesome vegetables and fruits, and in the juices of *fresh* meat, but *they are wanting in cheese*, having, on account of their great solubility, been left behind in the whey.

This absence of potash appears to me to be the one serious objection to the free use of cheese diet. The Swiss peasant escapes the mischief by his abundant salads, which eaten raw contain all their potash salts, instead of leaving the greater part in the saucepan, as do cabbages, &c., when cooked in boiling water. In Norway, where salads are scarce, the bonder and his housemen have at times suffered greatly from scurvy, especially in the far North, and would be severely victimised but for special remedies that they use (the mottebeer, cranberry, &c., grown and preserved especially for the purpose. The Laplanders make a broth of scurvy-grass and similar herbs). Mr. Lang attributes their recent immunity from scurvy, which was once a sore plague among them, to the introduction of the potato.

Scurvy on board ship results from eating salt meat, the potash of which has escaped by exosmosis into the brine or pickle. The sailor now escapes it by drinking citrate of potash in the form of lime juice, and by alternating salt junk with rations of tinned meats.

I once lived for six days on bread and cheese only, tasting no other food. I had, in company with C. M. Clayton, son of the Senator of Delaware, who negotiated the Clayton-Bulwer Treaty) taken a passage from Malta to Athens in a little schooner, and expecting a three days' journey we took no other rations than a lump of Cheshire cheese and a supply of bread. Bad weather doubled the expected length of our journey.

We were both young, and proud of our hardihood in bearing privations, were staunch disciples of Diogenes; but on the last day we succumbed, and bartered the remainder of our bread and cheese for some of the boiled horse-beans and cabbage-broth of the forecastle. The cheese, highly relished at first, had become positively nauseous, and our craving for the vegetable broth was absurd, considering the full view we had of its constituents, and of the dirtiness of its cooks.

I attribute this to the lack of potash salts in the cheese and bread. It was similar to the craving for common salt by cattle that lack necessary chlorides in their food. I am satisfied that cheese can never take the place in an economic dietary, otherwise justified by its nutritious composition, unless this deficiency of potash is somehow supplied. My device of using it with milk as a solvent supplies it in a simple and natural manner.

* Before the Adulteration Act was passed, mustard flour was usually mixed with well-dried wheaten flour, whereby the redundant oil was absorbed, and the mixture was a dry powder. Now it is different, being pure powdered mustard seed, and usually rather damp. It not only lies closer, but is much stronger. Therefore, in following any recipe of old cookery-books, only about half the stated quantity should be used.

THE SENSES IN INFANTS.

(*Continued from page 315.*)

When we come to consider the development in infants of touch and sight, we are surprised to find, that authorities are much divided in their estimate both of the tactile sensibility and the powers of vision displayed by the new-born infant.

Now, in dealing with these divergent opinions, it is obvious that we may either pit the various psychologists against each other, and elect to put faith in some rather than in others on grounds of general knowledge of their scientific reliability, accuracy, and so forth, or we may assume that the discrepancies in recorded results are due to great individual differences in infants, and proceed, therefore, to impartially enumerate all the conflicting statements. This last course being the more scientific, is the one we shall adopt.

We will begin with touch.

Dr. Kussmaul and others hold that from the very beginning touch is a finely-developed sense, and Mr. Sully goes so far as to hazard the suggestion that even taste is at first scarcely differentiated from it. Professor Preyer, however, maintains that at birth there is such a low degree of skin susceptibility, that the nose, hands, and lips of the new-born infant may be pricked with impunity—the child neither starting, nor betraying any other sign of discomfort.

The Professor did not himself try this experiment, nor would we counsel our readers to do so; but he claims to have arrived by other roads at the same conclusion, one of his proofs being that the infant does not blink when the water of its bath splashes into its eyes.

Without expressing any opinion as to the soundness of the professor's deductions, we will content ourselves with saying, that every one—Professor Preyer included—agrees that within three days of birth the child's skin susceptibility is very great, particularly for those tactile sensations which are most closely connected with sensations of temperature, and which are involved in the contact of the child with its nurse's or mother's body. Grimaces and movement moreover testify to the fact that the sensation of tickling is soon felt in full intensity under the appropriate stimulus. Darwin, when one of his children was seven days old, tickled the naked sole of its foot with a piece of paper, whereupon the child jerked its foot away and curled its toes as older children do when tickled. Perez again noticed that in the very youngest children disagreeable tactile sensations would call forth grimaces. Altogether, then, we may consider there is fair ground for saying that touch is not one of the tardily developed senses.

Far otherwise, however, is it with sight. If we are to believe some of the statements made on the subject, this sense requires for its development twenty or thirty days.

At birth, of course, no child sees,—so far all authorities concur. But, while Dr. Kussmaul and Professor Preyer declare that a child cannot fix an object — that is, cannot "bring the eye into such a position that the image of the object may fall upon the point of most distinct vision in the centre of the retina"—before it is three weeks old; and Perez and others, going further, say not before the end of the fourth week,—Darwin, on the other hand, declares that his child's eyes were fixed on a candle as early as the ninth day, and Mr. Sully asserts, in reference to the infant Clifford, that on the second day "the previously futile attempts to bring the two eyes into harmonious action were crowned with a measure of success, and they were observed to converge for an instant on the father's face if held invitingly near. By the fourth day the command of the eye was far greater, and it was possible to notice the effect of an object in attracting the organ in a particular direction, if not too far from that of the point previously looked at."

Equally great difference of opinion prevails with regard to the act of turning the head towards the light. G. H. Lewis affirms that it takes several days before the child makes any movement of the head towards the light, and Prof. Preyer sets the limit at six days; but Dr. Kussmaul states that he saw one child perform this act on the second day, and his observation is borne out by the testimony of the philosopher Tiedemann, who, a hundred years ago, noted that his infant son sought the light from the very beginning. It is perhaps only just to mention that Tiedmann's son grew up later into as eminent a man as his father, and it may, therefore, well be urged that he was what nurses call a forward child, and no criterion for others. But making due allowance for this, we have still before us evidence of a very conflicting kind.

This much, at least, is clear, that it usually requires between two and three weeks for the sense of sight to come into full operation, and that its gradual development takes place somewhat in this wise.

From the very first there is a slight but appreciable susceptibility for sensations of light, as is proved by the two facts, that the pupil of the babe's eye contracts under the influence of strong light, and that in some instances sleeping infants, when two or three days old, have been made to screw up their eyes, start, and wake, when a candle has been brought near their closed lids. Now, this sensibility of the eye to light induces vague spasmodic movement on the part of that organ, and out of these movements the fixing of the eye upon objects gets gradually developed. The eyes of the new-born child move quite independently of each other, the one going to the left, the other to the right, and one sometimes moving alone, but little by little symmetrical action is evolved. The following a moving object with the eye is a later acquisition, and the colour sense is also somewhat in abeyance. It is an open question what colours children are most attracted by; some prefer yellow, some red, but there is no doubt that they are all repelled by black. The power of accurately discriminating red, green, yellow, and blue is not manifested, Professor Preyer says, before the beginning of the child's third year.

The moving object attracts the child's attention more quickly than the stationary one, even though the latter chance to be brightly coloured. The more complex sensations of sight—the sensations of form, apparent size, distance, volume, and position are all late manifestations, for the child of ten or eleven months will stretch out its arms and try to grasp the moon; and will even in its third year make futile efforts to thrust large playthings into small boxes.

When we pass from sight to hearing, we find almost perfect agreement amongst psychologists. The infant, as we have had occasion to say before, is born perfectly deaf, but within three days of birth becomes so sensitive to sound, that any sudden noise will make it start and blink its eyes. In the child Clifford a distinct movement of the head in response to sound was observed on the second day. Darwin tells us that in the case of his child, sounds made it start and wink its eyes much more frequently than did sight. But he goes on to add, "Although so sensitive to sound in a general way, he was not able, even when 124 days old, easily to recognise whence a sound proceeded, so as to direct his eye to the source." Children are very early pleasantly excited by music or singing, Tiedemann's son showing the greatest liveliness and joy when, forty days after birth, he heard the piano played for the first time. Perez points out that clear, tinkling sounds, especially when repeated rhythmically, never fail to give pleasure. Discordant, shrill, deafening noises, however, when once they cease to alarm by their newness, do not seem to offend the infant's ears, as they do those of the adult—a truth to which all can testify who have had much to do with healthy young children, and have learnt by rather disagreeable experience that "everything does for them to make a noise with."

A. M. H. B.

The Largest Locomotive in the World.—This is now being constructed in the Sacramento carriage-building shops of the Central Pacific Railway. It will weigh 73 tons, and have five pairs of driving-wheels. The tender will weigh 25 tons, and the total length of engine and tender will be 65 feet.

SUBMARINE CABLES.

THE facts that the sum of £12,545,000 has been invested in the one French and seven English cables providing telegraphic communication between Europe and North America, that the majority of this investment came from the British public, and that the present market value is only (approximately) £7,000,000, give evidence, were evidence wanting, of the interest that is felt by the speculating and moneyed public in oceanic telegraphy. Apart, however, from a shareholder's point of view, the interest evinced by the "general" public from the time that the first Transatlantic Cable was laid, and for his share in which operation Mr. C. Bright received the honour of knighthood, down to the present moment, is a keen one. Nor is this interest confined to the cables above-mentioned. Events of the past few years have progressed at so rapid a rate, changes in political geography have been so extensively and unexpectedly made, that the saying that "upon the feeble strands of copper connecting the various quarters of the globe depends the fate of empires," is not altogether without a warrant. It would be an interesting calculation to sum up the grand total of the telegraph systems throughout the world, more especially as only a few days since the fiftieth anniversary of the erection of the first telegraph line was celebrated in Germany. Equally interesting, too, would be a study of the improvements that have been made year by year, and almost month by month, in the development of the various systems in vogue. In the case of submarine telegraphy, much has been learned, but most probably much more remains to be learned. The average life of a cable is very short, and is affected by a multitude of causes. The connection between the electrician, the geographer, the physicist, and the naturalist in cable-laying and repairing is so close that anything bearing on the subject is sure to receive ready and careful attention. It is therefore not impossible that the meeting of the Society of Telegraph Engineers, held on the 29th ult., will form one of the landmarks in the history of industrial science. A lengthy discussion resulted from a short paper, contributed by Captain S. Trott and Mr. F. A. Hamilton, in which the authors took up a most daring amd startling standpoint. In effect they endeavoured to demonstrate that in one of the most important details of cable manufacture we were utterly at fault, that not only were we failing to do that which is right, but that we were absolutely doing our best to insure the inefficiency of the cable. This opinion from one who has probably had more practical experience in repairing deep sea cables than any other living man, demands the most serious consideration. It is no wonder then that several gentlemen, many of whom could record considerable experience in cable laying, were placed upon their mettle, and entered into the discussion with the greatest interest.

As our readers are probably aware, the general method adopted in the manufacture of a cable is to enclose the copper conductor in one or more coatings of gutta-percha, or other insulating material, to surround this with a layer of tarred hemp, and to envelop the whole in a heavy iron armour composed of stranded stout iron wire.

The principal accidents to which these cables are liable may be briefly enumerated (say the authors) as follows:—Abrasion by ice and on rocky and stony bottom; ruptures caused by vessels' anchors; injuries inflicted by marine insects; *and the wringing asunder of the core by the iron wires.*

Accidents arising from the first cause have not been numerous; indeed, taking into consideration the heavy masses of ice that beset the coasts and banks of Newfoundland and Cape Breton Island, and extend far west along the shores of Nova Scotia, it is marvellous that so few cases of crushing have occurred.

With regard to breaks on rocky and stony bottom, it is worthy of remark that, excepting in the case of those which have taken place in the immediate vicinity of the shore or in very shallow water, few can be recorded; and we may here state, as the result of long and careful observation, that cables are rarely chafed through, and we believe that injuries attributed to this agency should in some instances be put down to quite another cause.

The number of breaks which have occurred to some cables, in consequence of fishing-vessels hooking them with their anchors, is greatly in excess of those brought about by any other means; but as these accidents are to a great extent unavoidable, and are easily and rapidly repaired, we will dismiss this portion of our subject with the remark, that considering the number of vessels engaged in the great fisheries on the banks lying between the meridian of 48° and 70° West, the wonder is that the cables are not broken far more frequently.

In reference to faults caused by marine insects, it can be said that, although the Atlantic cables have not enjoyed a complete immunity, they have been remarkably free from any very serious attacks of these borers, and, as their assaults can be repelled by well-known means, we do not consider the question a very prominent one, as far as Atlantic cables are concerned.

It is, however, on "the wringing asunder of the core by the iron wires" that the authors have chiefly to speak. Records are very numerous showing that cables have "suddenly snapped without any perceptible cause," and, "with everything favourable, have parted silently and suddenly;" breaks which, according to Dr. Russell, "seemed to point to some mysterious agency existing in the depths of the ocean, beyond the perception of science or man's contral." "The agency described as *mysterious* still exists," say the authors, "and the history of some of the most recent Atlantic cables, if published, would prove that these so-called improved types are liable to the same mishaps as those we have mentioned; indeed, they are even more liable, for, notwithstanding their strength, it is quite as difficult, and even more so, to recover them from deep water." The question is asked, "Why do cables suddenly sever in deep water whilst being submerged, or when being picked up, and even after being successfully submerged?" The answer is, that

Iron-armoured cables have a strong tendency to twist or curl, as the spiral *lay* of the wires imparts a constant helical force in a direction contrary to the *lay*.

Consequently, any slack given is apt to result in a kink or a succession of kinks, which is followed by a wringing asunder of the fabric when the strain is renewed. This accounts for most of the misfortunes which have happened in submerging some cables, for whenever it became necessary to stop or slacken speed in shifting from one tank to another, or for some other purpose, the risk of this accident has always been incurred.

An iron-armoured cable cannot be recovered from deep water excepting in short lengths, because the operation of heaving-in causes the armour to unlay or untwist, and this results in an accumulation of turns at and near the ocean bed, and a wringing or wrenching asunder of the fabric is sure to occur.

Cables sometimes break in deep water, because when the iron wires become weakened by corrosion, the curling or untwisting tendency is unopposed, and the stronger portions on either side of the weakened spot untwist, thus exerting a force contrary in direction on each side, but concentrated in action at the damaged portion.

This is the whole secret—this is the mysterious agency, and thus it is that the most serious cause of injury to submarine cables must be attributed to the iron wires.

Further on the authors maintain that gutta-percha is practically indestructible, but iron wire has caused the loss of many miles of submarine cables, and that, excepting when in contact with iron, vegetable fibre is indestructible.

We could (the authors declare) cite numerous instances of cables having been lifted from considerable depths solely by means of the yarn portion of the fabric, which retains its strength sufficiently to bear the superincumbent weight of oxidised iron wires. The core serving, which is composed of common jute yarn, has time after time done duty as the strength-giving material, although

only intended as a padding for the iron armour. The core serving is invariably recovered in a wonderful state of preservation, but the yarns which envelop the iron wires suffer deterioration whenever the latter become oxidised.

The testimony with regard to the enduring qualities of vegetable fibrous material is, in our opinion, so overwhelming, that we are justified in believing it will be readily admitted that a cable constructed without iron wires, and with the strength-giving material composed of hemp, will not possess within itself the elements of decay.

In the opinions of the authors :—

The strength-giving material, by means of which the core can be submerged and recovered, should consist of fibrous yarns or strands made up in such a manner that any twisting or wringing of the fabric is prevented; and, in order to accomplish this, we lay over the insulated conductor a series of spiral or helical servings of non-metallic fibres, yarns, or cords, laid alternately left and right, the fibres, yarns, or cords of each serving being twisted in a direction the reverse of that in which they are wound about the insulated conductor.

This point or feature, although at first sight a trifling consideration, is of the utmost importance, as it constitutes the gist and substance of the principle by means of which any twisting or knuckling of the cable is prevented; for it will be seen that, if the yarns or cords of each serving be similar—that is to say, if they be twisted in the same direction in forming them—the cable will kink, notwithstanding the servings be wound alternately in right and left hand spirals about the core.

A cable such as we have described would not only be more durable than an iron-armoured one, but could be recovered with ease and certainty from any depth.

Strength, lightness, and durability are, we affirm, among the chief requirements in a submarine cable, and these qualifications are to be found in the type which we now submit to the consideration of this Society.

In the discussion that followed the reading of this remarkable paper, the chairman (Mr. Willoughby Smith), who said the company with which he was connected had laid 94,000 miles of cable, of which Mr. Ford had superintended 60,000 miles, maintained the superiority of an iron sheathing, and doubted the possibility of a hemp-sheathed cable enduring the strain.

But the authors, in reply, stated that they had had a cable constructed on their pattern across Halifax harbour for eighteen months, and were in every way pleased with its performance. They said, furthermore, that they had had ample evidence of the wringing action, and in reply to a question put to them by Mr. W. H. Preece, it was stated that the rupture of the cables, when being picked up, invariably took place upon the bottom and at a point where no tension existed, and where no other force could be conceived to exist but the torsion which the authors called "wringing." The production of a piece of rope known to have been submerged in 1801, and only recovered three years since, proved the durability of hemp. It was practically as good as ever, and the only difference apparent was that the major portion of the tar had been squeezed out.

The result of the discussion is yet to be seen; but there is no doubt that it has awakened in the breasts of all interested in the question an intense curiosity, which can only be satisfied by prolonged and careful experiment.

W. Slingo.

NEGLECTED INSECTS.

E. A. Butler, B.A., B.Sc.

BUGS! "Horrid things," you say, no doubt. But stay, my friends, you are thinking only of that disgusting phlebotomist, the bed-bug, the *Acanthia lectularia* of the learned, concerning which there cannot be two opinions. This creature, however, does not really belong to English soil; it is an importation from "foreign parts"; it is, moreover, only one member, and that the most disreputable one, of an extensive group. As it is almost the only representative of that group generally known, we have no other common name for its relations, and so whenever the word is used, it is suggestive only of personal discomfort and foul smells.

I do not know that the matter is much mended if we call the creatures "Hemiptera-Heteroptera," the dissimilar-winged half-wings! This is, too, sesquipedalian, and so bugs I suppose they will have to remain to the end of their days. The creatures are in very many cases beautiful—sometimes exquisitely so; they are frequently grotesque, bizarre, with some parts of their body worked up into the oddest of shapes, as though Nature had experimented with them, and had tried to see how far she could go in altering the form of a member without altogether changing it into something quite different. To all, therefore, who delight in the beautiful or the curious, let me recommend the study of our British bugs, of which we have over 400 kinds.

They are found amongst tall grass, thistles, and nettles, at roots of plants, on the foliage of oak, hazel, and other trees, on furze-bushes and broom, in moss, amongst dead leaves, amongst rubbish at the bottom of haystacks, on the trunks of trees, on palings, in sandy places, under bark, in mud at the bottom of ponds, in ditches and streams, and on the surface of still water. Some of those that live in water are tolerably familiar objects, and are known by such names as Water Boatmen, Water Scorpions, and Water Measurers. A few of the terrestrial kinds sometimes intrude themselves on our notice, appearing in our streets and on our doorsteps, and have received the name of Bishops' Mitres. But the vast majority are scarcely ever noticed by any but those who specially look for them, though they are some of our most abundant insects, are around us everywhere, and may be found with very little trouble.

Excluding for the present the aquatic species, we may say that the greater number readily fall under two heads, which may be conveniently called hard bugs and soft bugs, according as they are encased in a hard, unyielding, horny skin, or have a more delicate and flexible integument. They are normally four-winged insects, though in a large number of cases the wings are more or less imperfectly developed. One great peculiarity of the order is seen in the upper wings, which, instead of being, as in most insects, of uniform texture throughout, appear as if composed of several pieces, like a patchwork quilt. In the hard bugs there are three such pieces, two at the base of the wing, of a somewhat triangular shape, the base of one triangle being placed against one of the sides of the other, and of stout, stiff, horny texture, and one beyond these, thin and flexible, rhomboidal in shape, but with the outer angles rounded. It is this peculiarity of difference in consistency in the different parts of the fore-wing that has suggested both the names Hemiptera (half-wings) and Heteroptera (dissimilar wings). In the soft bugs, in addition to the parts above named, there is a small triangular piece, wedged in, as it were, between the membranous part and one of the basal triangles. This little wedge is sometimes of a much more brilliant colour than the rest of the wing. One occurs to my mind at this moment in which this wedge is of a fiery red, while the greater part of the rest of the insect is deep black. The hind wings are quite plain, and of a very delicate membranous consistency. When the insect is not flying, the hind wings are completely concealed by the other pair, which lie along its back, overlapping one another at their outer extremity, just touching in their middle, and receding from one another towards

their attachment to the body, so as to leave a triangular space, which is occupied by a sort of scutcheon. This latter is often brightly and conspicuously coloured, and is sometimes so large as almost entirely to cover body, wings, and all. The head is very small, but is often borne on enormously broad shoulders—if I may use such a term with reference to an insect. The head carries a pair of jointed appendages which may be likened to strings of exceedingly-attenuated sausages. These go by the name of "antennæ," and in insects generally are composed of a large number of minute joints, but in the present order of a small number of elongated pieces. The middle of the head is prolonged into a kind of snout, from which there proceeds a long-jointed sort of sheath, which, when not in use, is folded back underneath the body, as one might imagine an elephant's trunk might be turned back between its fore-legs. It can be brought out from this position, and stretched in a sloping direction in front of the head. It carries inside four long, sharp-pointed bristles, which can be used to pierce minute holes in the tissues of the animal or plant upon whose juices the creature feeds. The legs of bugs, which are six in number, as usual amongst insects, are long and slender, and forcibly suggest the necessity for much padding if one would produce any semblance of calves.

I am afraid I cannot acquit these insects of the charge of smelling badly. In some of the larger bugs the smell is worse than that of *Acanthia*, and of the same nature. If you are "sweeping" with your net, *i.e.*, passing it backwards and forwards amongst rank herbage, and happen to enclose one, you will probably be informed of its presence by your nose before your eye detects it; but in the majority of our British species the smell is only slight, and frequently almost imperceptible, and in all it passes away with death. Some even exhale a fragrant odour. The smell is produced by a fluid which is excreted from two small openings on the under surface of the body, and is, no doubt, protective in function. Some bugs, especially the soft ones, take very readily to the wing, others never fly at all, but grovel on the ground, roaming about amongst the roots of plants or amongst rubbish, or clinging to the stems and leaves of the plants themselves.

They appear during the summer months, and but few are to be found at other seasons. They pass through a series of changes, after the manner of insects in general. The young bug, when first hatched, is not very unlike the adult in general appearance, though very small and wingless; by a rapid imbibition of nutritious juices, it increases its corporation till the inner man (or rather bug) becomes too great for the outer, when the skin bursts and a new creature emerges, larger and somewhat altered in colour and shape; the same thing goes on again, and is repeated until the final form is reached, each new stage presenting a closer approximation to the appearance of the adult. In the penultimate stage the rudiments of wings put in an appearance, but true wings are never present till the final stage. During all these preliminary transformations, the integument of the insect is soft and yielding, even in the case of those that acquire great hardness when arrived at perfection. The object of this is obvious. It would be fatal for the creatures to be encased in an inflexible armour during the earlier part of their career; there would be no room for expansion, and so no possibility of growth; but when the final stage is reached, there is no such difficulty, for perfect insects do not grow, though they go on eating. The food taken by the perfect bug, no doubt, goes to assist it in its reproductive function, which is really the only business it has to perform when fully grown, and previously to this stage this function has been impossible, as the insect has been sexually immature.

Bugs, then, differ from the majority of insects in not passing through a quiescent stage previous to the assumption of the adult form. Those insects which pass through such a stage, which is familiarly known in the butterflies and moths as the "chrysalis," are in their earliest life totally unlike what they are destined to develop into, and during their quiescent pupahood the vast modifications that have to take place before the creature appears in its adult form, are elaborated out of the store of nutriment laid up in the body during the preliminary stages. Now the bugs are already, at the commencement of their life, so similar in general form to their adult shape that the changes they have to undergo are comparatively trifling, and therefore no quiescent stage seems to be necessary. Bugs live entirely upon juices which they extract from plants or animals. The hard bugs seem to favour an animal and the soft ones a vegetable diet; this, however, must not by any means be taken as a hard and fast rule. Some are attached to special plants, apparently because they either derive their nutriment directly from the plant, or indirectly from other insects that feed upon the same plants.

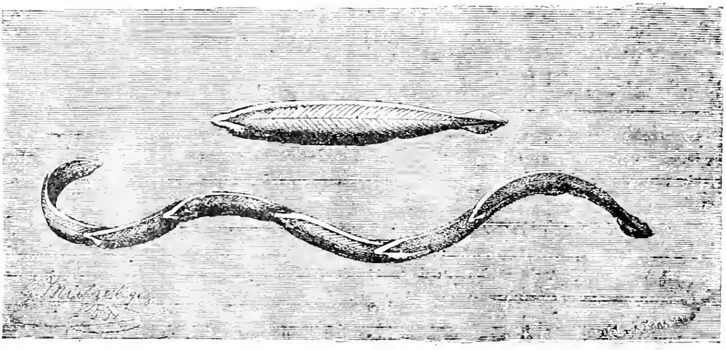
As a rule, they are not to be regarded as coming under the category of useful insects. When a plant is, so to speak, tapped, and its juices gradually absorbed, it, of course, tends to become weak, shrivelled, stunted, and unhealthy; and, therefore, any creature which feeds on vegetable juices may be reckoned, *à priori*, as likely to become injurious to man, since his welfare so largely depends upon the vegetable produce of the soil. But, in this particular instance, little damage seems to be done, as the plants principally attacked are wild species of no economic importance. There are a few plants which seem specially liable to the attacks of bugs; the different kinds of grasses are much infested, furze and broom have each their special inhabitants, nettles and thistles afford a home and food to large numbers, rest-harrow and heath are much frequented by some species, and amongst trees, oak, hazel, sallow, birch, ash, and fir have each their own peculiar hemipterous fauna. Amongst those which imbibe the stronger aliment, there is one large species that inhabits outhouses, lumber-rooms, &c., and it is sufficiently cannibalistic to prey upon its near relative, the bed-bug. It is popularly called the Fly-bug, and is in its earlier stages much addicted to the curious habit of piling little particles of dust upon its back; these adhering to the hair that cover its body give it a peculiar fluffy appearance.

If you would see bugs at home and pry into the secrets of their life, go in July or August to a flourishing bed of nettles or thistles, or to some luxuriant patches of ragwort, sit down beside the plants and carefully look them over, without disturbing them. It will be surprising if you do not see plenty of bugs of a fairly active character engaged in seeking their livelihood or courting their spouses. They will be chiefly green, a favourite colour with *soft* bugs, and may easily be recognised by the characters of wings and beak referred to above, for there are no other insects to which those descriptions apply. If you wish to secure them, a bag of stout calico attached to an iron ring and stuck in a handle should be vigorously and rapidly drawn backwards and forwards across any patch of rank herbage, and in this way with very little trouble large numbers will be obtained. They will generally prove very active in the net, and many will be sure to escape either by flight or by running over the edge of the net; still, a sufficient stock may easily be obtained by a few sweepings, and may be transferred to pill-boxes, in which they will safely travel.

THE LANCELET FISH.

THE lancelet (*Amphioxus lanceolatus*) has so little similarity to other members of the fish family that for a long time it was undecided whether it belonged to the vertebrate or invertebrate class. Its body is about five centimètres long, slender and angular, symmetrically tapering off to a point at each end. A slender fin extends from the head around the extremity of the tail and terminates at the vent. The mouth, a mere longitudinal fissure, is under the front part of the body, and its orifice is crossed by numerous cirri. This fish has no heart, the place of that organ being taken by tubular vessels having a pulsating motion, which drives the transparent colourless blood into the smaller veins. It has no bones, the muscles being attached to soft cartilage, and the spinal cord is not protected by a bony covering. The body is covered by a delicate skin without scales. It is found in the seas of the torrid and temperate zones. It lives in the sand, in which it buries itself, and being so nearly the colour of the sand, it is completely concealed, and is often only perceived when the sand is washed through a fine meshed sieve. Probably, wherever it makes its appearance it is far more abundant than is generally supposed. If it is necessary for it to leave the sand, it swims through the water with a gliding, serpent-like motion, and with the quickness of an arrow, but in a short time it embeds itself again in the sand. Mr. Couch was the first captor of this fish on the British coast, and found his first specimen in the sand about fifty feet from the receding tide. He says that when swimming the head can hardly be distinguished from the tail.

Mr. Wilde put one of these fish in a tumbler of water. "It moved round the glass like an eel, and, although no eyes were perceptible, it avoided the finger or any substance put in its way, stopping suddenly or turning aside from it." The mouth is surrounded by cilia, the motion of which causes the passage of water for food and for breathing.

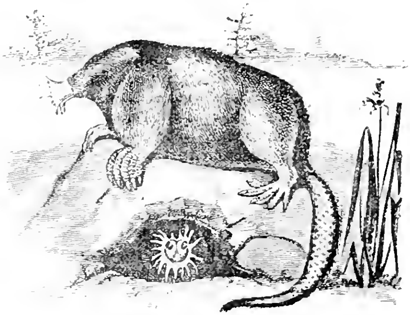


The Lancelet Fish.

These fish have a peculiar and remarkable power of attaching themselves to each other, sometimes clustering together, sometimes forming a string from fifteen to twenty centimètres long. In the latter case they swim in unison, with a serpent-like motion. When swimming in a line they adhere to each other by their flat sides, the head of one coming up about one-third on the body of the one before it, as seen in the engraving.—From *Brehm's Animal Life.*

THE STAR-NOSED MOLE.*

THE star-nosed mole is strictly an American animal, and its genus is confined to America alone. Its great peculiarity lies in the strange formation of its nose—or, rather, its nasal appendages. The muzzle, which is a kind of cartilaginous disc, sending out about twenty fibres or feelers, when viewed from the front has the appearance



The Star-Nosed Mole.

of a star, hence the common name "star-nosed." The two cartilaginous fibres situated beneath the nostrils are the shortest. The use of this radiating process has not been fully ascertained, but it is quite probable that it is extremely sensitive, and is used for detecting the presence of its prey. It always touches or feels an object with this "star" before swallowing it.

The star-nose is subterranean in its habits, and rarely quits the ground, at least during the day, and hence it is seldom seen. It is generally found in moist valleys along the banks of streams, and consequently does not damage gardens and lawns by digging furrows through them, like the common mole. Its food consists of earth-worms, and the grubs of beetles, cicadas, and other ground-dwelling insects. In captivity it will eat raw meat of any kind.

During the breeding season the tail of the star-nose becomes greatly enlarged, and this form has been described

* From *Scientific American.*

as a *new* species. Its fore-feet, like all the moles, are very powerful for the size of the animal, and are formed for burrowing in the ground. It makes rapid progress in soft earth, but upon the surface its movements are awkward and slow.

Its nest is large, and composed of withered grasses and leaves, and is mostly situated in an excavation beneath a stump or log. In the very young animals the radiations on the nose are but slightly developed.

Its eyes are small and rudimentary, almost concealed in the fur, and it is extremely doubtful whether they have the power of vision even in the slightest degree. In their dark burrows eyes would be of no use to them; on the contrary, they would be a source of inconvenience, inasmuch as they would continually be irritated by sand and dirt. There is an orifice in place of an external ear, which does not project beyond the skin.

The body is covered with dense soft fur, brownish-black above, a shade lighter beneath. The length of the body of the star-nose is about 5 in., and of the tail 3 in.

C. Few Seiss.

Editorial Gossip.

We are glad to see that our former contributor, Dr. Andrew Wilson, is about to give four popular lectures on Anatomy and Physiology, in Princes' Hall, Piccadilly. The subjects are—The Skeleton; Joints and Muscles; the Heart and its Work; the Nerves, Brain, and their Work. These are subjects in which we all have a very direct personal interest, and treated as in Dr. Wilson's hands they are sure to be, they cannot but be found at once most attractive and most instructive.

In a few weeks a new year, and with it a new volume of Knowledge, will commence. Although we have every reason, from the communications which reach us, to believe that our readers are well pleased with the weekly contents, it seems well at this season to consider whether there is not room for improvement, and also what new subjects may be desirable for the coming year. Without "seeking to proticipate" the work of the whole year, we wish to indicate the following points as forming part of our plans.

First, we propose more rigidly than of yore to exclude all that even approaches religious controversy. In our earlier numbers we promised that everything relating to religious dogma should be excluded; but as regards those thoughts associated with science which bear on what has been called natural religion we expressed no such purpose. Nor indeed do we now. No contributor or correspondent need fear that anything he may write expressing his sense of the mystery which lies at the back of all the truths and all the discoveries of science, will be deleted as unsuited to these columns. But we must exclude all attempts either on the one hand to emphasise such expressions of individual opinion, or on the other hand to make them the subject of controversy. Letters addressed *with either purpose* to the editor will be simply acknowledged as received, but no word of reply will be given them.

Among the subjects for the new year, we may mention that arrangements are in progress for a series of papers on insects by Mr. Butler, a paper from whose pen appears in the present number. We hope to have from the pen of Mr. Grant Allen a series of papers on the flowers of the year. Mr. Slack's interesting papers on microscopic work will be continued, as will those by Mr. W. Mattieu Williams on the "Chemistry of Cookery." Mr. Thomas Foster, whose papers on the "Morality of Happiness" are drawing to a close, has promised a series of short papers on "How to be Happy," by which we understand him to mean, how to be as happy as may be, in what Liebnitz called "this best" (but not perhaps happiest) "of all possible worlds." Mr. Clodd will contribute shortly some papers on Dreams and Dream Philosophy, and later a series on Evolution (already in preparation). The papers on "How to Get Strong," which thus far have dealt rather with general principles than details, will be continued fortnightly during the year, each presenting special exercises adapted for particular classes and for the strengthening or "limbering" of particular muscles. F.R.A.S. (whom some of our correspondents insist on identifying—quite mistakenly—with the editor) has promised to continue fortnightly, besides the "Face of the Sky," his interesting account of work with a 3-inch telescope, taking planets, moon, sun, stars, or nebulæ, *pro re natâ*,—we beg pardon, we should have said, as occasion may arise. Mr. Slingo will give a series of simple and practical papers on electro-plating, which we trust may encourage many to amuse their leisure with very interesting experiments. The Editor proposes to begin and continue fortnightly two series of papers. One of these will be on the Almanac, taking *Whitaker's Almanac* as the special work of reference, and explaining month by month the various statements made in that wonderfully complete almanac, respecting the rising, setting, &c., of the sun and moon, the equation of time, the positions, &c., of the planets, and the phenomena of the skies generally. From a great number of letters which have reached us we believe such papers will be found useful. The other series will relate to mapping, presenting and illustrating the various methods of map projection which are used in treatises on geography, astronomy, &c. We know of no better way of encouraging geometrical tastes, and few better ways of stimulating geographical and astronomical inquiry, than the practice of making maps and charts on various systems of projection. The work is within the capacity of all, it is more interesting than many pursuits specially intended for amusement, and more instructive sometimes than the most profound and abstruse calculations.

In our first two volumes we gave, as systematic astronomical illustrations, the star-maps forming the volume now published as "The Stars in their Seasons"; in the third and fourth volumes have appeared the series entitled "Sun Views of the Earth." The fifth and sixth volumes will present a series of "Zodiacal Maps," on an adequate scale, forming when completed a set showing the entire zodiac to a breadth of about 10 deg. north and 10 deg. south of the ecliptic, each map overlapping its neighbours on either side by several degrees. These maps will show the stars black on a white ground for convenience in marking in the paths and positions of sun, moon, and planets either in 1884 or in any other year.

The papers on Chess and Whist will be continued as before. We have invited Mephisto to resume our original plan of presenting occasional short studies of the leading Chess openings. We continue to regard Whist as well as

Chess as a scientific game, though some correspondents who apparently know little of the game and nothing of its real charms, objurgate us for allowing what they call a mere chance game to be dealt with in these columns. We invite those who so view Whist to study the game which adorns our Whist column this week, and to consider whether an average problem in Mathematics would more effectively test the powers of combination than the problem which was presented to all four players at the close of this remarkable game. Whist is of course, like Chess, to be regarded really as a mental relaxation only, not as a suitable subject for profound time-consuming study; but that it should be so excellent as a recreation yet so actively exercising the mind (as cricket, football, and like good recreations tend to strengthen the body) justifies its recognition here as worthy of a place alongside that prince of scientific home-games, Chess. Yet Whist, unlike Chess, will not appear weekly.

"Our Mathematical Column" we no longer promise to continue *seriatim*, though it will by no means disappear. Should it reappear as a *weekly* feature, it will probably be limited to illustrative problems of interest to students as akin to those which appear in examination papers.

We cannot promise at present such increase in the quantity of matter offered to our readers as can only be safely and steadily provided for when our circulation has attained to a number already definitely decided upon. Some readers have pointed to publications kindred to Knowledge in certain respects, which offer more matter to their readers. We can only reply that if we filled these columns with correspondence, borrowed matter, and matter offered for nothing (and for the appearance of which in type the authors would even be willing to pay), we could safely purvey half as much matter again as weekly appears in our pages. But as matters actually are, the case is otherwise. Among the objects in view when Knowledge was started, the appearance weekly of a certain amount of original matter was not held to be the least important. The Editor may also remind readers that the time devoted to Knowledge by him is not spare time, but time specially withdrawn from other work. It is most pleasant to him, and worth some sacrifice of time and labour, to be brought directly into communication with great numbers of those who have kindred tastes and follow kindred studies. He trusts the pleasure is mutual. But for this as for everything that is worth anything, he has to pay a price; and what he can afford rather than what he would wish to pay has to be considered.

Readers have however shown so kindly and considerate an interest in Knowledge and its progress, that the work cannot but become constantly lighter and more pleasurable. Each who adds one to the number of our readers does his share towards doubling our constituency; and with each such increase comes "the promise and potency" of increased efficiency and value in Knowledge itself.

The Editor desires to state that during the last four weeks he has been prevented from attending to literary work as he could wish, by the return of head pains similar to those which followed the railway accident of July 21st last. These seem now yielding to treatment.

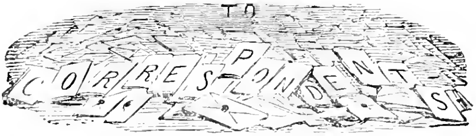
THE FACE OF THE SKY.

From Dec. 7 to Dec. 21.

By F.R.A.S.

Fine individual spots and groups of spots continue to appear upon the Sun's face, which should be examined on every clear day. The aspect of the night sky will be found delineated on Map XII. of "Stars in their Seasons." Mercury is for all practical purposes invisible, his great south declination involving him in the horizontal mist of the winter sky—an observation which applies equally to Venus. Mars does not south until morning, but may be very fairly well seen after ten or eleven p.m. The angular diameter of his disc increases to 13″·4 by the 21st; but he is, of course, under these circumstances, a relatively small object, and requires a powerful telescope to scrutinise him with anything like a satisfactory result. A small one, however, will suffice to show that his disc is still gibbous — *i.e.*, less than a circle. Mars is in the barren part of the sky, to the west of Leo ("The Stars in their Seasons," Map III.). Jupiter is by far the most brilliant object now in the night sky, and is very well placed for the observer, although he still souths after midnight. He is situated to the south-west of the "Præsepe" in Cancer (same map). The phenomena of bis Satellites visible before 1 a.m. during the period covered by our notes are as follows:—To-night (7th) Satellite III. will re-appear from occultation at 11h. 58m. p.m., and the shadow of Satellite I. come on to Jupiter's face at 12h. 6m. On the 8th an eclipse of the First Satellite will happen at 9h. 18m. 26s. p.m., the same Satellite reappearing from occultation (of course, after passing behind the body of the planet) at 12h. 32m. On the 9th the shadow of Satellite I. will quit Jupiter's disc at 8h. 54m., followed by the Satellite casting it at 9h. 50m. p.m. On the 10th the ingress of the shadow of Satellite II. will happen at 8h. 25m., Satellite II. itself coming on to the planet's face at 10h. 15m. At 11h. 19m. the shadow will pass off the opposite limb, Satellite II., though, not doing so until between 1 and 2 a.m. on the 11th. There will be an eclipse of Satellite III. on the 14th, at 8h. 36m. 24s. p.m., and one of Satellite I. on the 15th at 11h. 11m. 50s. On the night of the 16th four sequent phenomena will reward the student. At 8h. 28m. the shadow of Satellite I. will enter on to Jupiter's face, followed by the Satellite itself at 9h. 16m. The shadow will leave the planet at 10h. 48m., as will the Satellite at 11h. 36m. On the 17th Satellite I. will reappear from occultation at 8h. 44m.; the ingress of the shadow of Satellite II. will happen at 11 o'clock, and that satellite will begin its own transit 33 minutes after midnight. On the 19th II. will reappear from occultation at 10h. 25m. On the 20th the comparatively rare phenomenon of a transit of Satellite IV. will occur, and should be carefully watched to determine whether the Satellite is invisible while superposed on Jupiter, whether it looks brighter than his belts, &c., or whether it looks dark, like its own shadow. Curious observations of transits of the two outer Satellites are extant, and no opportunity should ever be lost of watching them across Jupiter's disc. Satellite IV. will leave the planet's face at 11h. 5m. p.m., on the 20th. On the 21st, Satellite III. will be eclipsed at 12h. 34m. 48s. p.m. Finally, on the night of the 23rd, the ingress of the shadow of Satellite I. begins at 10h. 22m., the Satellite follows its shadow at 11h. 1m., and the shadow passes off 42 minutes after midnight. Saturn travelling away from ε Tauri in a westerly direction ("The Stars in their Seasons," Map I.) continues to be almost as favourably placed as he can be for the observer. There is no sensible change in the opening of his ring-system. Our drawing and description in p. 319 will instruct the student exactly what to look for in this wonderful and interesting system. Uranus is not yet fairly visible; but any one who cares to regard a seeming-dullish 8th mag. star, may fish for Neptune some 3° or 4° south of ζ Arietis (Map I. of "The Stars in their Seasons.") Pons' Comet of 1812, to which we have previously referred on pp. 292 and 319, travels during our specified period from the north-eastern part of Lyra across Cygnus, passing over a portion of the Milky Way between the 11th and 21st. The moon's age at noon, to-day, is 7·7 days; and, quite obviously, on the 21st, it will be 21·7 days; so that, up to about the 18th, she will be very well situated for the observer. During the interval covered by these notes, four occultations of stars will happen at convenient hours. The first will be that of the 6th mag. star, B.A.C. 1272, which will disappear at the moon's dark limb at 6h. 10m. p.m. on December 12, at an angle from her vertex of 9°; and will reappear at her bright limb, 37 minutes later, at an angle of 296° from her vertex. On the afternoon of the 13th, *m* Tauri, a star of the 5½ mag. will disappear at the dark limb, at a vertical angle of 96°; to reappear at the moon's bright limb at 5h. 23m. p.m., at an angle of 200° from her vertex. At 7h. 20m. p.m. on the 15th, λ Geminorum, a 3½ mag. star, will disappear at the moon's bright limb at an angle from her vertex of 37°, reappearing at her

dark limb at 8h. 14m. p.m., at a vertical angle of 236°. Finally, on the night of the 18th, 16 Sextantis, a star of the 6th magnitude, will disappear at the bright limb of the moon, at an angle of 45° from her vertex, at 11h. 6m. It will subsequently reappear at 8 minutes after midnight from behind her dark limb at an angle from her vertex of 204°. At noon to-day the moon crosses the boundary between Aquarius and Pisces, which last-named constellation she does not quit until the same hour on the 10th. She then passes into Aries, her passage across which occupies until 3 a.m. on the 12th, when she enters Taurus. She remains in Taurus until 10 a.m. on the 14th, at which time she moves into the extreme northern part of Orion; this takes her 11 hours to traverse, and she leaves it for Gemini at 9 o'clock the same evening. She occupies until 11 a.m. on the 16th in crossing Gemini, which she then leaves for Cancer. At 2 a.m. on the 18th, she crosses the boundary into Leo, and at 9 p.m. on the same day descends into Sextans, which she takes just 24 hours to traverse, returning to Leo at nine o'clock at night on the 18th. She quits Leo for Virgo at 11 p.m. on the 20th, and is still in Virgo when our notes terminate.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

IS THE SUN GREEN?

[1034]—The double stars present the phenomenon of suns with *complementary* lights. All stars do not appear to shine with white light. May it not, then, be possible that our sun appears green to the eyes of beings in other solar systems than ours? "But if it were green, it would be seen to be green," most persons would exclaim. This, however, is by no means a necessary consequence. My contention is, on the contrary, that *the eye becomes insensitive to the tone of the light by which it is illuminated;* as young artists find to their cost in first attempting to paint by artificial light. Unconscious of the yellowness of their *gas-sun*, they take no account of the altered values of their yellow pigments. Objects reflecting vibrations of the same periodicity as the gas-light will appear white; and so it would be if the artificial source of illumination were of any other hue, say, for instance *green;* in which case, the green tints of the same periodicity as the illuminating source would also appear white,* and so on. This may be illustrated by various experiments. Moreover, I am induced to believe that our sun appears green in planetary systems lighted by stars shining with other coloured lights than our own, from the fact that *green* occupies the *mean* position in the *prismatic* spectrum, and therefore represents the average effect which is produced on eyes outside of our solar system, by the neutralising action of the rays, of opposite periodicities, on each other. The values of the mean elements of any two correspondingly opposite colours, both in Young's and in Herschel's tables of wave lengths, &c., too closely agree in every case, with the numerical values of the central green, to be regarded as a fortuitous coincidence.

In the foregoing remarks I have used the language usually adopted in writing and speaking on the subject of light, although it is very incorrect and very misleading, but it is difficult to do otherwise, without resorting to considerable circumlocution. Nevertheless, according to the undulatory theory—and strictly scientifically speaking—objects, the sun included, only appear to be either luminous or of certain colours. These phenomena of light and colour are really but the affections of sense, appearances produced in us by mechanical vibrations of various wave lengths, &c. They do not inhere, as most people suppose, in the vibrations and the objects themselves. An expedition undertaken in order to discover whether the sun be red, green, or violet would, therefore, if the words were literally interpreted, be simply an absurdity.

W. CAVE THOMAS.

* Whiteness is, in my view, the effect of the neutralised, or average, action upon the retina of any special series of vibrations.

STRANGE COINCIDENCES.—DOUBLING OF CAPITAL, &c.

[1035]—In reference to the motion of the magnetic poles, Sir Snow Harris makes the following observations:—"By a curious coincidence these periods (1740, 860, 4609, 1304 years) involve a number, 432, sacred with the Indians, Babylonians, Greeks, and Egyptians, as being dependent on great combinations of natural events. Thus, the periods 860, 1304, 1740, 4609, become, by a slight modification, 864, 1,296, 1,728, 4,320, which are not inadmissible, considering the complicated nature of the observations from which the first numbers are derived. Now, these numbers are each equal to 432 multiplied by 2, 3, 4, and 10 successively. According to the Brahmin mythology, the world is divided into four periods, the first being 432,000 years, the second 432000 × 2, the third 432000 × 3, the fourth 432000 × 10. It is also, according to Hanstein, not unworthy of remark that the sun's mean distance from the earth is 432 half radii of the sun; the moon's mean distance 432 half radii of the moon; but what is more especially striking is the circumstance "that the number 25920 = 432 × 60 is the smallest number, divisible at once by all the four periods, and hence the shortest time in which the four poles can accomplish a cycle. Now, this time coincides exactly with the period in which the precessions of the equinoxes complete their circle—certainly a curious and remarkable series of coincidences."

Problems concerning the doubling of population, capital, &c., may be solved by the following formula, which is, I think, simpler than that furnished by your correspondent "T. J. B." (972) :—

$\left(1+\frac{1}{x}\right)^n = 2.$ Here x or n may be readily found. The reason for the rule is also very plain; thus: Let a = the number of people or amount of capital and $\frac{a}{x}$ the first year's increment; then

$a+\frac{a}{x}$ = number at end of first year.

$$\left(a+\frac{a}{x}+\frac{a+\frac{a}{x}}{x}\right) = a+2\frac{a}{x}+\frac{a}{x^2} = \text{number at end of second year.}$$

$$\left[a+2\frac{a}{x}+\frac{a}{x^2}\right]+\frac{a+2\frac{a}{x}+\frac{a}{x^2}}{x} = \left(a+3\frac{a}{x}+3\frac{a}{x^2}+\frac{a}{x^3}\right) = \text{number at end of third year.}$$

Or generally $a + m\frac{a}{x} + n\frac{a}{x} + p\frac{a}{x} +$ &c., m, n, p, &c., being the coefficients of the binominal $\left(1+\frac{1}{x}\right)^n$ = number at end of nth year. We can therefore put $a\left(1+\frac{1}{x}\right)^n = 2a$; or $\left(1+\frac{1}{x}\right)^n = 2$

$$\text{Whence } 1+\frac{1}{x} = \sqrt[n]{2}$$

$$\frac{1}{x} = \sqrt[n]{2}-1$$

Ex.—At what rate must a population increase annually in order to double itself in 100 years?

$$\left(1+\frac{1}{x}\right)^{100} = 2; \text{ or } \frac{1}{x} = \sqrt[100]{2}-1$$

$$\frac{1}{x} = {\cdot}00695; \quad x = \frac{1}{{\cdot}00695} = 144$$

$$\text{or } \frac{25}{36} \text{ per cent.}$$

In what number of years will a population, increasing at this rate, double itself?

$$(1+{\cdot}00695)^n = 2$$

$$n = \frac{\text{Log } 2}{\text{Log } 1{\cdot}00695} = \frac{{\cdot}30103}{{\cdot}00300} = 100 \text{ nearly.}$$

R. JONES.

THE SEVERE WEATHER OF THE 13th–15th.

[1036]—Probably "H. J. Poole," and "your readers generally," will be interested by the following particulars of observations made on temperature here—one of the stations of the "second order"—at the same time that those published in Knowledge of last week were made by him in the S.W. of England:—

Night of 12th, minimum temperature on grass,	25·5	deg.
" 13th, " " "	23·0	"
" " " in Stevenson's screen (4 ft. above ground)	28·3	"
Day of 14th, maximum temperature in screen,	41·0	"
Night " minimum " "	30·0	"
" " " " on grass,	26·1	"

Temperature of air (dry bulb in screen) at 9 a.m. on 14th, 32·5 deg.

The wind at 9 p.m., 12th, was blowing light airs from S.S.E., and continued so till early morning on the 15th, when it went to the south.

It is very remarkable that the minimum temperature in "H. J. Poole's" screen should, on the night of the 12th, have been 1·5 deg. *below* that registered by the minimum thermometer on grass.

As he remarks, it does not appear that such severe weather is at all normal for this period of the year, especially in this district, which is supposed to be favoured with a tolerably equable and moderate temperature. It is, however, very evident that the late spell of sharp weather, occurring as it did between two periods of moderately warm weather, was pretty universal.

Probably it is not generally known that this short period of severe cold was preceded and followed by a considerable electrical disturbance of the atmosphere, as indicated by the occurrence of very vivid flashes of lightning (without thunder) for several nights. My station is 137 ft. above the sea-level and close to the sea. My instruments are very accurate, having been just examined by the inspector from the Meteorological Office, London.

In concluding, I may say that there has been no fog here this month.—I am, sir, faithfully yours,

Peel, Isle of Man. T. H. Davis, F.R. Met. Soc.

TRICYCLES.

[1037]—Having read your paper for some time, and being much interested in the different articles, I see one on the 16th in reference to tricycles, by Mr. Browning, and can readily endorse the advice he gives in reference to leather mud-guards for front-steering tricycles. These are a great boon in winter and wet weather, as it is almost impossible to get the metal guards to thoroughly protect the feet and ankles from being very much splashed; and for ladies they are most requisite. As regards guards for large wheels, this, I think, a more difficult thing. 1st. As to adaptation of fitting. 2nd. Wind resistance. Where machines are made a proper width, there is rarely much trouble, except in windy weather, when the mud is blown from the wheels to rider.

In reference to the brakes, I cannot altogether agree with the writer of your article, where he speaks of tyre brakes being almost extinct. These I have now tried over a period of three years with the greatest comfort, on a Cheylesmore rear-steerer, and as they are at present fitted, have found them perfectly reliable on the steepest hills; in fact, some of my friends touring on the Continent have found them thoroughly efficient even in the ascent of the Alps. Should band brakes be properly constructed, the application of a little chalk will generally be found to answer every purpose, as resin, although making the brake very powerful, often causes a loud, screaming noise, which is most unpleasant, and often frightens horses. A Rider.

TRUTH STRANGER THAN FICTION.

[1038]—I think the difference in carriage (of charged and uncharged cells) was on account of the supposed danger of cells being full. 17s. 6d. is not the carriage for returns empty, and I believe that charged batteries travel as dangerous goods.

John Alex. Ollard.

LETTERS RECEIVED AND SHORT ANSWERS.

A. N. S. That letter still in hand. Full of interest, but space not yet free.—E. W. Wallis. Am unable to find space for the multitudes of such announcements sent me.—Adelaide Proctor. Weakness appeals to strength for pitiful consideration · it shall not plead in vain. For the mental illness of which your letter presents the symptoms, I know, alas, of no remedy. The poetess, deceased, whose name you borrow (but not with sufficient c's) was *not* mathematical: she *was* however a lady.—C. W. Vind. Your suggestion is worth careful consideration. I will convey it to the several writers.—J. Hamer. Thanks. Wish you would state the varied readings.—Rhedarum Artifex. Know nothing about trustworthiest books on Traction.—D. H. Davis. Thanks. Letter in type. But for periodical reports we have no space.—M. F. D. Many comets do circulate constantly round the sun. A comet which passes eventually away from the solar system is one which came originally from space beyond his domain, and had there a velocity independent of that which he can impart as the comet approaches him. The recession results from the acquired velocity and the original velocity of approach combined, the former being gradually parted with as the comet recedes, but the latter remaining.—S. C. Walford. That promise was made before a certain railway accident, which much interfered with all my plans.—H. H. Have preferred (hoping you will not object) to send picture to engraver, to do his best with.—C. E. Williams. Know of no work dealing with the insects mentioned in Shakespeare's plays, nor whether Mr. Patterson's book on the subject is in print.—W. Tregay. See Editorial Gossip. Would have attended to this matter sooner; but all my literary work has been hampered for several weeks past by the return of head pains such as followed recent railway accident.—G. E. S. Wagner. The subject of thought-reading is under investigation. For my own part, I see nothing outside the range of scientific inquiry in the matter.—H. Clarke. It is not for astronomers to change accepted modes of speaking about sunrise and so forth. We should be ridiculed, and very rightly, if in ordinary talk we spoke of "man rising to the heavenly bodies" as you suggest; and we should be no nearer to exactness after all.—H. N. Smith. Suez Canal matters hardly in our line.—W. H. Jones. Many thanks; but have not space for Magyar Folklore.—P. S. I really do not know why there are so many cats with eyes of different colour.—J. W. My opinion can be of no real value; but I should say the cocoa-nut fibre would be best.—Senex. You ask me what is the soul. No soul can say. We may call it *animula vagula blandula, hospes comesque corporis*—but that don't help us.—C. Your trisection incorrect, as you will see at once if you apply it to small angles.—C. Fen, Thesauros, and others. Thanks; but another explanation in type when yours received.—H. Moulton. That method would do if we could tell the exact moment of partial eclipse beginning. We cannot, however.—W. Cave Thomas. I think Prof. Langley has fairly succeeded in showing that the sun is violet; but that is the colour before absorption by his vaporous surroundings. Your letter is in type.—Chas. Rivington. Thanks for *Shanghai Mercury* with amazing illustration of commatic perversity.—A. M. D. Some think one way some another. *I* think there is much room for improvement in the human race.—F. Shervill Ruthin. Already answered, but thanks.—Novice. Alpha Centauri nearest.—J. A. I suppose Huxley to mean all experience, without considering whether such experience can be all collected.—J. Reid. The question whether the first day of this century was Jan. 1, 1801, or Jan. 1, 1800, amounts really to the question whether there are 1800 or 1799 years in eighteen centuries. With you I cannot but wonder how such a question came to be "disputed among educated persons."—Naga Putnam. Thanks for extracts, and very pleasant accompanying letter.—R. Barrington. Address not left.—Uncertain. See "Editorial Gossip."—B. Potamian. Thanks. I know nothing, of myself, on the subject. Boys well, now in America. Remember both our interviews perfectly well.—Victim to Misplaced Confidence. Have received other such letters, followed shortly by announcement that articles were received, though late. Hope it will be so in your case.—W. L. Browne. Regret; but fear no space for series. If separately sent would try to find room. Meantime, will insert the one sent, which is separately valuable.—J. Shorland Aplin. All since July 1st.—J. Treluse. Unfortunately, such questions lead to gratis advertising.—W. S. Bradley. The right ascension of an object is in reality the interval in time between the passage of the first point of Aries (intersection of equator and ecliptic, where sun crosses ecliptic northwards) and the passage of the object across the meridian. Calculation of lunar quarters scarcely suitable subject for short answers.—C. W. B. For life history of paste and vinegar eels see text-books, in which these creatures are dealt with. The mental influence known as mesmerism is undoubtedly a scientific fact, be the explanation what it may. Many have pretended to be so influenced who were not; but idiotic persons of that sort infest all such departments of inquiry.—J. Gray. All the planets go the same way round; but the satellites of Uranus and Neptune retrograde round their primaries.—F. Thompson. I do not want you to believe in any pole, north or south, or European.—A Lover of Logic. Story amusing; but—perhaps through inexperience you word it as though *we* thought the same of our coincidences—instead of which we specially referred to them as utterly unimportant.—H. J. Hardwicke. Those matters will be touched on in our Zodiac papers; not suited for short replies.—A. P. T. Lines very apt. Shall appear soon.

Our Whist Column.

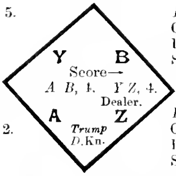
By "Five of Clubs."

The following is the game referred to in our last three numbers. It appeared in the *Field* a few months ago, and was contributed by Mr. N. B. Trist, of New Orleans. The notes and criticisms are by Cavendish; the additional notes by the Whist Editor of the *Australasian*:—

The Hands.

Y.
Diamonds—K, 9, 7, 5.
Clubs—8, 4, 3.
Hearts—Q, Kn, 10.
Spades—K, 9, 2.

B.
Diamonds—A, Q, 10, 8, 3.
Clubs—K, 9, 5.
Hearts—9, 4.
Spades—8, 7, 5.

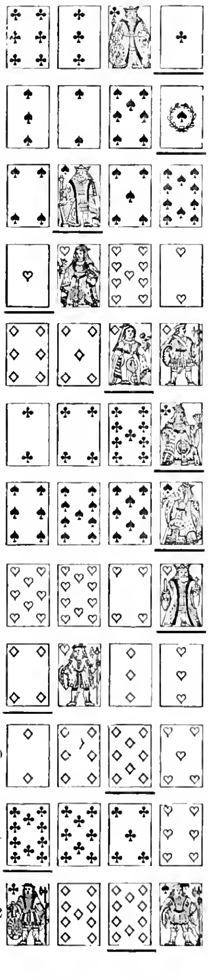


A.
Diamonds—6, 4, 2.
Clubs—Kn, 10, 7, 6, 2.
Hearts—A, 8.
Spades—6, 4, 3.

Z.
Diamonds—Kn.
Clubs—A, Q.
Hearts—K, 7, 6, 5, 3, 2.
Spades—A, Q, Kn, 10.

A Y B Z

1 2 3 4 5 6 7 8 9 10 11 12



13

And A and B win the odd trick.

NOTES AND CRITICISMS.

Note.—The card underlined wins the trick, and card below leads next round.

Trick 2.—It is a question whether Z should not open the Heart suit, but Z's hand is not under examination.

Trick 3.—B has called.

Trick 5.—A notes that B has the Three of trumps. B can place all the remaining trumps.

Trick 9.—Z ought to lead the Knave of Spades, on which his partner should discard the Eight of Clubs, when Y and Z win the game. A plays a masterly *coup* in trumping with the Four. His argument is as follows:—My partner, with his weak hand, would not have called for trumps unless he had at least five trumps, two honours. All the other trumps are in Y's hand. I know my partner has the Three of trumps, and as it is most probable that he has not Ace and King, or he would have continued trumps at Trick 6 instead of trying to give me the lead again, I shall most likely have to lead twice through Y in order to make every trick, which we require to save and win the game. But even then I shall fail if my partner has to lead trumps up to Y. I must therefore give my partner an opportunity of playing the *grand coup* with his Three of trumps if he deems it advisable to do so.

Trick 10.—B plays the *grand coup*, undertrumping his partner. If he discards the Club he loses the game. Though B plays extremely well, A's *coup* in trumping with the four is entitled to the palm.

ADDITIONAL NOTES.

Trick 6.—A believes in the penultimate game. He drops the Two of Clubs to this trick. Therefore there are at least three more Clubs in his hand.

Trick 9.—Z, knowing that there are three more Clubs in A's hand, knows also that A holds only two more trumps; and if he has noted the card played by Y at trick 5, he can infer that both these trumps must be smaller than the Five. It is evident, therefore, that in this illustrative hand A derives no advantage whatsoever from his use of the penultimate signal in Clubs. All that he does is that at a critical stage of the game he gives his adversary, Z, detailed information as to the position of three of the remaining Clubs and two of the smallest trumps; and, so far as we can see, A's public intimation as to these facts leaves Z without excuse for his lead of a Heart at the ninth trick, whereby he affords A and B the opportunity, of which they skilfully avail themselves, of pulling a lost game out of the fire.

But further, A has dropped the Eight of Hearts to the eighth trick, B the Nine, and Y the Ten. Therefore the Knave of Hearts is marked in Y's hand; and both A and B are void of the suit. Moreover, B returned the Nine of his partner's suit at the sixth trick, and hence he cannot have more than one Club remaining in his hand. Consequently, when Z leads to the ninth trick, he knows that B most probably holds four of the remaining trumps, together with one Club. Therefore he may count Y's hand to consist of the Knave of Hearts, together with three trumps and one Club. If that Club be the winning Club, Y and Z will win the odd trick whatever Z may now lead. The same thing is true if Y hold the King and Ten of trumps. But if the winning Club be with A, Z's remaining chances of scoring the odd trick are that among his three trumps Y holds either the King or the Ten and the Nine. Hence, if Z lead the long Spade he gives Y the double chance, either of discarding in the event of his holding a losing Club, or, in the event of his holding the command of the Club suit, of over-trumping A. In other words, the lead of Z's long Spade places Y in the best possible position for winning the odd trick, whilst the lead of the Heart transfers to A and B the complete control of all the conditions under which they can save and win the game.

Lastly, it needs no proof that at every stage of a game of Whist, and most of all at its most critical stage, the direction of the play ought to be left to the partner who has the greater trump strength. Hence, as the Knave of Hearts may be fairly assumed to be in Y's hand after his lead of the Queen at the fourth trick, it is evident that Z ought to have led a small Heart rather than his King of Hearts at the eighth trick.

Society for Psychical Research.—A general meeting of this society was held at 11, Chandos-street, Cavendish-square, on the afternoon of November 22nd. The President, Professor Henry Sedgwick, opened the proceedings with a few remarks, in which he emphasised the importance of extending the area of experiments on thought-transference, in order to multiply the number of persons of unblemished character which those who deny the genuineness of the phenomena must logically conclude to be "in the trick." Mr. F. W. H. Myers then congratulated the society on the extension which had actually taken place, and which had shown the faculties involved in thought-transference to be much commoner than had been at first supposed, and he described in detail a series of experiments made by himself and Mr. E. Gurney, in conjunction with Mr. Malcolm Guthrie, J.P., of Liverpool, on the communication of tastes. These trials had the advantage that the knowledge of the impression to be communicated was confined to those three gentlemen, and the hypothesis of collusion by a code of signals was thus excluded. The experimenters used a great variety of substances, and in a large majority of cases the substance which one or other of them had in his mouth was correctly named or described by the "subjects." Mr. Guthrie followed with an interesting account of the manner in which the experiments with these particular "subjects" had originated; and he exhibited a large number of diagrams, which they had been enabled accurately to represent by a transference of the impression of the original from the mind or brain of the experimenter without spoken words or contact of any sort. Many of these results had been obtained by Mr. Guthrie himself, others by some member of the investigating committee of the Society for Psychical Research, when experimenting alone with one of the "subjects," information by collusion being thus as effectually precluded as information through the ordinary sensory channels. Professor Balfour Stewart then pointed out how illogical is the rejection of these facts as contradictory of known biological laws, they being clearly only an extension of science, such as has been again and again exemplified in its other branches. Finally, Professor Barrett described some trials which showed the extraordinary degree to which muscle-reading could be carried, and also recounted a long series of very careful experiments strikingly exhibiting the power which a mesmerist can sometimes exercise over a "subject" by silent willing. Other papers were deferred for want of time.

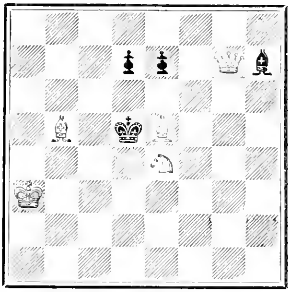
Our Chess Column.

By Mephisto.

PROBLEM No. 109.

By C. Planck.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Pearson's Problem, p. 235.

No. 33.

1. Q to R8	Kt tks Q (best)
2. Kt to B6	Anything
3. Mates accordingly.	

No. 49.

1. Kt to R3	B to Kt2
2. Q to Kt5	Anything
3. Mates acc. with Q or Kt.	

No. 105.

1. Q to K8	Kt tks Q (best)
2. P tks Kt (Kt)	Any
3. Kt to Q6 mate.	

No. 106.

1. Q to KKt2	P to QB5 (best)
2. Kt tks KP(ch)	Any
3. Q mates accordingly.	

No. 107 (a Black P on KKt2).

1. K takes B	K to K3 (ch), or	1.	K to Q5 (ch)
2. B to B5 mate		2. R to B5 mate.	

If Kt moves Q takes R mate.

Note.—Problem No. 108 has, unfortunately, a double solution.

There will shortly be published a highly interesting collection of End games, by Herr B. Horwitz, the renowned collaborator of the book by Kling and Horwitz. We understand that besides the old specimens, there will be a valuable collection of newly composed positions published. As at the present time there does not exist another book on endings, we look forward to the publication of this book to supply a long felt want.

FIRST NOTICE.

Games Played in the London International Chess Tournament, 1883.*

We have much pleasure in informing our readers that the book of the tournament has been published The book is edited by Mr. J. I. Minckin, and its appearance within five months of the tournament bears testimony to the energetic industry of its Editor. Zukertort, Steinitz, Mason, and Bird have annotated their own games, while the largest portion of the games by other players have been furnished with notes by the Editor and Bird. Mr. Wayte has likewise assisted in annotating Tchigorin's games.

We regret to miss Blackburne amongst the commentators. Besides 242 games of the major tournament, the book also contains a selection of 54 games played in the minor tournament. There is also an introduction, giving a complete history of the tournament, together with subscription lists, balance-sheets, speeches, eulogisms, rules, &c. The book contains 371 pages, and is very handsomely got up and printed in bold type. It contains the most valuable collection of games played in modern times. Only a limited number having been printed, we would advise our readers to make an early purchase.

* London: Jas. Wade, 18, Tavistock-street.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Ralph Appleton.—Best thanks for games, which are welcome.

George Loxdale.—Solution incorrect.

Henry Bristow.—Problem received with thanks. All four solutions correct.

John.—If 1. P to B6, then Kt to R3, followed by the R checking.

G. Gouge.—After 3. Q to QKt4, K takes P without being mate.

Rev. W. Andersson, W., Berrow, A. S. Orr, Donna, R. T.—Solution of Problem 108 by 1. Kt to KB5, is unfortunately correct, but it is not the author's intended solution.

Correct Solution Received.—No. 49: Berrow, Clarence, H. A. N. No. 33: Clarence. Nos. 106 and 107: Ch. H. W., Hammich, T. B. S., R. T. No. 108: Clarence.

Safety in the House.—At a meeting of the National Health Society this week a communication was received from Mr. George Shaw, Master of the Plumbers' Company, in response to a communication which had been addressed to him from the society, expressing the desire to co operate with the Guild of Plumbers in promoting the systematic instruction, examination, and registration of plumbers. The Master of the Plumbers' Company intimates that the attention of the Guild is directed to this subject, and that methods of forwarding the desired object were under consideration, in which they would be glad of the co-operation of the National Health Society. In the previous year the National Health Society had instituted a series of lectures to plumbers, which were attended by audiences so large that the course had to be repeated, and a subsequent examination was held, which included the testing of practical work done by plumbers. This was conducted by Mr. George Shaw and Mr Ernest Turner. The results showed that, while, on the one hand, plumbers were evidently very desirous of better instruction, on the other hand their work was, in a great majority of instances, so defective, even among the picked men who appeared for examination, that only a small proportion of the prizes could be awarded, and very little of the work was of first-rate quality. Mr. Ernest Hart, the chairman of the National Health Society, read a paper at Liverpool on the subject, and will, in the course of the season, make a communication at the British Institute of Architects, with the view of securing the co-operation of that society; also in the much-needed measure of sanitary reform.

Contents of No. 109.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DEC. 14, 1883.

CONTENTS OF No. 111.

A NATURALIST'S YEAR.

By GRANT ALLEN.

THE ROBIN COMES FOR CRUMBS.

WINTER has set in at last in real earnest. The hoar frost coats the naked boughs of the young birches in the clump upon the snow-clad lawn; the grasses by the bank arch over in dainty filagree with the bending load of drifted flakes that bow down their laden heads so heavily; and the poor little freezing sparrows, huddled together, half dazed, by the garden palings, hardly know how to move or cheep in the bitter cold that seems to paralyse their feeble fluttering, limp, wee wings. The time has fairly come for the exercise of indiscriminate out-door-relief to these small winter pensioners of our inexpensive human bounty. Let us throw open the breakfast-room window wide and drop out the crumbs from the trencher on to the flower-bed below, for the benefit of these sad little frozen-out workmen, who stand expectant with sidelong eye on the shrubbery bushes in grateful anticipation of their accustomed charitable feast. See, now they fly down timidly from their coign of vantage by the flowering laurustinus shrub. They love to shelter themselves there, close by, or else below the aucuba and the Portugal laurels, whose broad evergreen leaves hide them securely from our too curious gaze—and they are busy picking up the precious morsels, or squabbling with one another (like wee thieves that they are) for the bigger bits that any one among their number may have chanced to annex in the general scramble. But when they have all fed their fill, with much bickering and snatching meanwhile, our own familiar robin, who lives all winter in the garden as his fixed residence, comes boldly up for his share of the good things going so freely, and takes his stand upon the window-sill itself without fear or trembling, to eat the special meal that we lay out there, after the others are satisfied, for the sole gratification of our particular ruddy-breasted favourite.

It is curious how readily the acquired instinct of fear for man in these naturally timid little birds dies out before the exercise of a few weeks' steady kindness on the part of a single household. It shows how much less rigid in its action instinct really is, than most people in their hasty, unthinking fashion are too easily prepared to admit. The ordinary idea about an instinct is that it is something absolutely fixed and immovable—a tendency which will act under given conditions, no matter what the final effect; inexplicable, mysterious, and even perhaps a trifle miraculous. But when we come to consider a very simple case like this one, it is easy to see both how the existing instinct originally arose, and how it can even now be so rapidly modified under favourable circumstances. And to begin with, let us ask first, what is an instinct? in order to decide whether the fear of man on the part of the small birds is or is not really instinctive.

According to Professor Bain's excellent definition, an instinct is "an untaught ability," though it would perhaps be still more correct to describe it as unlearnt than as untaught, for most knowledge acquired by the lower animals is gained rather by experience than by actual communication. Knowledge or power, independent of personal experience, is indeed the key-note of instinct. Now, judged by this standard, it is clear that the fear of man is instinctive with each individual bird in England; for even very young birds, which have never seen a man before, are known to be very much frightened at the first apparition of that ancestrally alarming and very bloodthirsty animal, who has hunted them down, shot them with gun, or still earlier, with cross-bow, and shied stones at them (especially in his immature or cub condition, when he is commonly known as a boy) for many thousand generations at the very shortest computation. In existing European birds terror of this destructive and extremely cunning carnivore is hereditary and intuitive in almost every unprotected species.

The origin of the instinct, however, as Mr. Darwin has shown, is one on which we have an unusual amount of historical proof; for there are a few uninhabited oceanic islands where the native birds show no fear at all of man, and have to acquire the habit of fearing him by a long and painful course of practical teaching. In other words, the dread of human beings, though antecedent to experience in the individual, is not antecedent to experience in the race as a whole. There is nothing in the mere outward bodily features of the human face divine to make it immediately and naturally an object of uneasiness and terror to the eyes and brains of birds as such. It is only by continuous persecution throughout many generations that the fowls of the air at last come to inherit a nervous system, so constituted that the very image of a human being falling upon the retina causes an immediate and intense desire to effect an escape, without the bird itself being able to understand the why and wherefore of its singular perturbation. What a melancholy tribute to our boasted supremacy over all living things, that even the harmless small birds instinctively avoid us, as the hereditary enemies of their persecuted race! The sight of a man alarms them antecedently to all experience, much as the roar of thunder alarms ourselves, as the smell of lions alarms the camel, or as the sight of a snake alarms the monkeys bred in the Zoo, and therefore unfamiliar by personal experience with the feud which has always raged between their respective ancestors in equatorial forest glades. Yet, on the other hand, in the uninhabited Galapagos archipelago Mr. Darwin found the whole animal world so free from fear of man that he could push a hawk off a tree with the muzzle of his gun, catch the big amblyrhyncus land-lizards quietly by the tail, and collect the small birds to drink from a basin of water held between his own hands. This primitive tameness is not easily lost, either, for in the Falkland Islands, where the birds have been more or less hunted down at times for nearly two centuries, they have not yet acquired any

very great terror of aggressive man, though they are gradually getting less and less tame as time goes on. Even in England, the big birds are much more cautious than the small ones; and perhaps the very wariest of all is the heron, which has been hunted and hawked after in former times more persistently, in all probability, than any other of our native birds. The great bustard, now practically extinct in Britain, but still found on the continent of Europe, is even more preternaturally suspicious of man, the bustard-stalker, than the heron himself. On the other hand, sea-birds which breed on isolated rocks, and so have little opportunity for forming an acquaintance with the ways of humanity, like penguins and boobies, are often so tame that they can be readily caught with the hand or knocked over by dozens with a sailor's knob-stick.

The instinct of fear is thus very gradually acquired, and only by dint of much bitter ancestral experience: but when once gained, it is comparatively easily lost, and may even be replaced by affection and confidence after a very short acquaintance, not in captivity only (where the bird has no option), but in the native condition. Sparrows, which, as the most town-haunting of all birds, have had especial opportunities of learning the fickleness and treachery of man (still generally in the form of boy), do not so readily make friends with us as do robins; but in Paris, where the habit of taking a stray shot at every small bird is far less common than in London, everybody must have noticed how familiarly even these street Arabs of the winged world will perch upon the shoulders of the benevolent old gentlemen who feed them daily in the Tuileries gardens. In cold weather, starlings and thrushes are also very easily conciliated: and the far timider woodland birds themselves can be tamed by some few exceptional people who have the faculty of inspiring animals with a sort of intuitive confidence. I have often tamed mice myself by offering them crumbs at judiciously graduated distances, till at last they would come upon the dinner table to be fed, a habit which appeared to cause more fear to the ladies present than to the little visitors themselves. In Jamaica the turkey-buzzards, or local vultures, which are protected by law as useful scavengers, have learnt their immunity so well, and become so bold upon the strength of it, that they will even sometimes fly into the houses, whence they are only ejected by some display of physical force on the part of the rightful owners. I once saw three turkey-buzzards devouring a dead dog by the roadside; and in order to test their freedom from fear I tried to drive them off from the carrion with my walking-stick. The experiment was so eminently successful in proving their fearlessness that at the end of one moment it was the experimenter himself who was beating a hasty retreat in the direction of the nearest negro cottage, pursued by three exasperated and threatening vultures, who seemed disposed seriously to resent so unwarrantable an infringement on their ancient legal rights and privileges.

THE ZONE OF SMALL PLANETS.

By Richard A. Proctor.

(Continued from page 329.)

So soon as we consider the theory of the solar system's origin to which all the known facts point, we find—as it appears to me—an explanation of all those features of the ring of asteroids which had seemed most perplexing or (it is nearly the same thing) most significant.

The known facts are these—

First, the singular distribution of the masses forming the system. *Secondly*, the departures from uniformity, as in the various inclinations of orbits, and of the rotational movements of the planets. *Thirdly*, more marked departures from uniformity on the outskirts of the system, seen in the reversed movements of the satellites of Uranus and Neptune, and probably in reversed rotations of these outer planets. *Fourthly*, the existence of millions of meteoric systems, moving in all directions and at all distances from the sun, on paths having every variety of inclination and of eccentricity. *Fifthly*, the marked resemblances between the systems of Jupiter and Saturn on the one hand and the Sun's special family of small planets (Mercury, Venus, Earth and Moon, and Mars) on the other. *Sixthly*, the gaps in the mean distances of the asteroids. *Seventhly*, and for our present purpose *lastly*, the gaps in the Saturnian ring-system, which like the zone of asteroids consists of multitudes of small bodies.

As I showed thirteen years ago in my "Other Worlds than Ours," all the first four features of the solar system correspond with the theory that each member of the system was *in large part* formed (Laplace's nebular hypothesis need by no means be absolutely abandoned) by meteoric aggregation. Without this theory those features are absolutely inexplicable. And as, even now, though at a greatly reduced rate, the process of meteoric ingathering goes on, our earth yearly gathering in an enormous absolute mass of matter in this way, however small that mass may be compared with the earth's, we *know* that the theory is a true one—though in what degree the formation of the various members of the solar system is to be explained in this way, may of course be open to question.

With regard to the fifth feature, I know nothing more suggestive of the meteoric stream theory of the formation of the solar system than this. Anyone who has watched some mighty eddying, whirling stream, and has seen how perfectly the minor eddies in such a stream present in miniature the features of the greater whorl of which they form part, will see how strongly the resemblance between (for instance) the system of Jupiter and the central part of the solar system—the sun's special family as I have learned to regard it—suggests the idea of a minor eddy in a mighty whirlpool, like the minor whorls in the great whirlpool nebula itself.

But now be it noted that the sixth feature, the characteristic gaps in the asteroidal system—a strange and altogether perplexing feature without this theory—is precisely what we should expect to find in any case where meteoric aggregation led to the formation of a ring of small bodies instead of a separate planetary mass. [I would ask the reader before proceeding, here, to study the illustrative picture of the asteroidal family, supposed to be distributed in circular orbits at their proper mean distances (see p. 291, No. 106): he will recognise, I think, the force of the evidence, and see how the objection raised by Professor Newcomb on the strength of two or three asteroidal orbits *near* one of the gaps disappears when graphic evidence replaces mere statistical investigation.]

Every member of a meteoric stream moving in a period which synchronised (in a simple way) with the movements of Jupiter's giant mass would undergo at each return to conjunction with Jupiter the same kind of perturbation. This renewal of perturbation acting in the same direction would result in an accumulated disturbance, affecting the mean distance. We see this on a grander scale in the case of Saturn, whose period nearly synchronises with Jupiter's in such sort that five periods of the Giant Planet are nearly equal to two periods of the Ringed Planet: hence results what is called the Great Inequality. Now apart from other causes of disturbance, the effect in the case of

any individual meteor would be to cause its mean distance to oscillate on either side of that particular distance which corresponded to a period synchronising (simply) with Jupiter's. But considering the millions of meteors forming the system or stream, and that these would all have periods oscillating through this mean value, it is evident that at any given moment there would be multitudes of meteors moving in that period, or at the mean distance corresponding to one of the gaps in the asteroidal zone.

But now notice that the meteors thus passing outside and inside their proper mean distances would enter regions traversed by other meteor streams, and that, the members of such streams being counted by millions of millions, collisions could hardly fail to occur by myriads. Every collision would in effect be the withdrawal of a meteoric mass, small or great, which until then had had a period synchronising with Jupiter's; for in whatever way a collision occurred the mass resulting from the collision would have a period differing from that of either of the colliding masses.

Such processes would, in general, be part of the long series of processes leading to the eventual formation of a single planet. But just within the orbit of the mightiest of all the planets, Jupiter, and where the velocities due to solar influence begin to be great (this region being comparatively near to the sun) the combined disturbing influences would be better able than anywhere else throughout the solar system to prevent the formation of a single planet, and would lead, instead, to the formation of a zone, or rather a system of zones of small aggregations. These zones would be separated by gaps, either wholly or almost wholly free, corresponding to the distances at which Jupiter's disturbing influence would be most effectively exerted.

The circumstance that such gaps exist precisely where on this theory they would exist affords, certainly, strong evidence in favour of the theory.

But when we turn to the seventh point noted above the evidence seems to become decisive.

In the Saturnian ring-system we have a zone of multitudinous small bodies, travelling each in its own special orbit around the central ruling orb, Saturn. Whether we have here a region where other satellites besides those already formed around Saturn are in process of formation, or a region which will be, for all time, occupied by zones of tiny bodies, we need not here stop to inquire. It is sufficient that we have in the Saturnian rings, actually present before our eyes, a stage in the development of a system resembling the planetary family. Of course, it might be urged that here we have evidence of the bursting of two or three Saturnian satellites which formerly travelled around the planet where now we see two or three rings; but I hardly think this theory will be advanced, or (if advanced) successfully maintained. Setting it aside, we find in the Saturnian rings the analogue of the asteroidal system. *There*, on a small scale, are precisely such gaps as we have in the asteroidal system on a larger scale. The gaps are not quite free from small satellites, for if they were they would be as black as the shadow of the planet on the ring, and they are not black, but brown or dark grey. They are regions whence the small satellites have been almost wholly swept away. If the same sort of action can be recognised here that I have considered above in the case of the asteroidal zone, no manner of doubt should, I imagine, be entertained as to the validity of that interpretation of the gaps in the asteroidal system. But the very same cause has been recognised. Professor Kirkwood, of Bloomington, Indiana, with that keenness to detect such neat proofs which characterises him, and led me long since to call him the Kepler of modern astronomy, has shown that the gaps in the Saturnian ring system lie precisely where the perturbing action of the neighbouring satellites would be most efficient.

DARWIN ON INSTINCT.

"MULTIPLY, vary, let the strongest live and the weakest die." If not absolutely the last word, this is at least the last published utterance of the author of "The Origin of Species" and "The Descent of Man." In these ten words Darwin has expressed the conclusion of the whole matter, the ultimate result of a lifetime's patient and ceaseless research into the laws which govern terrestrial life. They are the concluding words of a paper by the late Mr. Darwin which his most faithful and loving disciple, Mr. G. J. Romanes, read recently at the Linnean Society This paper, or "Posthumous Essay," as Mr. Romanes calls it, is the full text of a part of Darwin's chapter on Instinct written for the "Origin of Species," but afterwards suppressed for the sake of condensation. This and other papers on psychological subjects, to the elucidation of which from a physiological standpoint Mr. Romanes has devoted himself, Darwin gave to his disciple and friend, with the request that the latter should publish any parts of them that he chose in his works on mental evolution. Mr. Romanes, however, after Darwin's death, naturally did not feel himself at liberty to appropriate and incorporate in his works, as his own, so much material carefully collected and sifted by the master's hand, and the value of which had become enhanced. He, therefore, rightly decided to give the last, as Darwin himself gave the first, of the "Origin of Species" to the Linnean Society. The paper itself appears as an appendix to his work on "Mental Evolution in Animals," published by Messrs. Kegan Paul & Co. But that work contains much more of Darwin than the appendix. He had collected many notes bearing on the subject of instinct over and above the suppressed essay, and most of these notes Mr. Romanes has introduced into the text of his own work, always taking care to indicate their authorship, and giving, moreover, a special index to the passages.

In the essay before us, Darwin endeavours to throw light upon the origin of four manifestations of what is usually called instinct:—(1) Migration; (2) Instinctive fear; (3) Nidification and Habitation; (4) Habitations of mammals; and after a few miscellaneous remarks on the subject of instinct and on cases of special difficulty, he states his conclusion. The subject of the migration of birds is one of the most curious and complex in connection with what we call the instinctive habits of animals. But the tendency is not confined to birds, though in that class it seems most marked and developed. As usual, throughout this essay Darwin piles instance on instance to shed light on all sides of the special point under discussion. After adducing various instances to prove how widespread the migratory instinct is, and how in seeking to satisfy it birds of the most delicate structure will cross hundreds of miles of sea, he endeavours to show how the more remarkable migrations could possibly have originated. He says:—

> Take the case of a bird being driven each year by cold or want of food, slowly to travel northward, as is the case with some birds, and in time we may well believe that this compulsory travelling would become an instinctive passion, as with the sheep in Spain [referring to an instance he gives]. Now during the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that

the impulse which leads the pinioned goose to scramble northward would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey.

The section on instinctive fear is even more interesting than that on migration, and requires and receives delicate handling and cautious investigation; it is marked by all the features which are so characteristic of Darwin's previous works, including that scepticism which made him slow to accept, without personal examination, instances which seemed most strongly to lead to the conclusion that he was inclined to accept. He shows that in unfrequented islands the wild animals have rarely any fear of man, and that this feeling is only acquired after considerable familiarity with the methods of the animals' most dangerous enemy. He then, in considering the manifestations of fear and the methods adopted to escape the dreaded danger, refers to animals feigning, as it is said, death, "an unknown state to every living creature," which seemed to Darwin a remarkable instinct; so he resolved to test it in the case of insects. He says:—

Hence I carefully noted the simulated positions of 17 different kinds of insects, belonging to the most distinct genera, both poor and first-rate shammers; afterwards I procured naturally dead specimens of some of these insects, others I killed with camphor by an easy, slow death. The result was that in no one instance was the attitude exactly the same, and in several instances the attitude of the feigners and of the really dead were as unlike as they could possibly be.

Of course, this does not bear at all against the hypothesis that these insects assumed their motionless attitude through fear, but only disproves the prevalent belief that they instinctively or intentionally feigned death. Moreover, Mr. Romanes refers in the text of his work to several very remarkable and well-authenticated instances among the higher animals of the assumption of attitudes so death-like as to deceive the most experienced observers.

Equally interesting and much fuller of instances are the sections on nest-building among birds and the construction of habitations by the higher animals, as the beaver. Nests especially, Darwin shows, have all forms. He says:—

In the nests of birds we have an unusually perfect series, from those which build none, but lay on the bare ground, to others which make a most imperfect and simple nest, to others more perfect, and so on till we arrive at marvellous structures, rivalling the weaver's art.

He shows that birds, under certain conditions, where the end can be otherwise accomplished, will lose the instinct of incubation entirely, and that, in fine, nest-building in itself, and the multifarious forms which nests assume are determined by the principle of natural selection, by adaptation to special conditions.

Darwin then goes on to consider several instances of special difficulty—cases, for example, of an instinct appearing only once in the lifetime of an animal, which, however, he proves are perfectly explicable on the great principle, which under his hands has unravelled so many mysteries, the principle that it is a matter of life and death to all organisms to be able to adapt themselves to their circumstances; and the instances which he gives of disadvantageous instincts only serve to confirm the truth of the great principle. In his conclusion, he says:—

We have in this chapter chiefly considered the instincts of animals under the point of view, whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory.

He then goes on to refer summarily to the various forms and modifications in which it has been found that instincts present themselves:—

Bearing in mind that in a state of nature instincts do certainly vary in some slight degree; bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which shows that it is at least possible that a complex instinct might have been acquired by successive steps, and which, moreover, generally indicates, according to our theory, the actual steps by which the instinct has been acquired, inasmuch as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species—bearing all this in mind, together with the certainty that instincts are as important to animals as their generally correlated structures, and that, in the struggle for life under changing conditions, slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvellous instinct known, that of the cells of the hive bee, we have seen how a simple instinctive action may lead to results which fill the mind with astonishment. . . . . . The imperfections and mistakes of instinct on our theory cease to be surprising; indeed, it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region would simply add one more to the myriads which have become extinct. It may not be logical, but to my imagination it is far more satisfactory, to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of the ichneumidæ feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies—multiply, vary, let the strongest live and the weakest die.

Such, then, is the clear and unmistakable conclusion of the posthumous fragment which Mr. Romanes has given in full to the world. It is the keystone, as it were, to the marvellous structure which, oppressed by almost constant suffering, Darwin spent his life in rearing. It may in the future be overtopped; it may, indeed, be only the central foundation for some larger and loftier structure, from the summit of which future generations may be able, with improved instruments, to see much farther into the mystery that surrounds us than we can ever hope to do; but it is impossible to conceive that it can ever be entirely swept away, that it can cease to be an important factor in solving the complex problems which will continue to present themselves to science, or that its author can ever be placed on a lower pedestal than that allotted to him by the greatest among his contemporaries.—*Times.*

HOW IS A LIFE ASSURANCE SOCIETY WORKED?

LET us hope there are not a few among our readers who are able to appreciate the advantages of life assurance. To such, a brief explanation of the principles upon which a life assurance society is worked may not be unacceptable; and at any rate it may show them and others upon what a secure system such societies are based, and may enable them the better to judge of the working and stability of any particular office.

Now, if the duration of life and the rate of interest were certain, any one could, by investing a certain sum at compound interest, secure a known amount at his death. To make this plainer: if every one died at 60, and the universal rate of interest were 3 per cent., a man of 20, by investing £1 a year at compound interest, would have accumulated at his death £75·4; and a man at 45, by doing likewise, would have £18·6. If then either of them

desired to leave £1,000 at his death, he would simply have to calculate what amount he would have to invest every year.

But, first, life is only too uncertain to admit of such a simple system as this; and it required the ingenuity of man to suggest a remedy by co-operation. A given area was taken, and the number of deaths at various ages were noted, and from these facts a table of the average duration of the lives in the area at the various ages, generally called a "Mortality Table," was drawn up. More recently the experience of the mortality among the members of several life assurances offices that had been established long enough to make their experiences reliable was taken, and a Mortality Table made out. Taking this last-mentioned Table, we find that if we take several healthy boys of 14, and several healthy men of 32, although all die at different ages—some only living a few years, and some attaining to a ripe old age—the average duration of the life of the boys will work out to 46 years, and that of the men to 33 years. Here then is the remedy for our difficulty, and if we deal with the masses, and if several boys of 14 pay us premiums of £1 a year during their lives, whether such boys' lives happen to be longer or shorter than the average, we shall with practical certainty not be losers if we agree to pay each on death the amount that £1 invested at compound interest will produce in 46 years, or £96·5, for one or other of them will pay us during their lives an amount which, if invested at compound interest, will produce that sum for each. And in a similar manner we can deal with the men, only, as their lives have the shorter duration of 33 years, we can only agree to pay each of them £55.

But secondly, the rate of interest is fluctuating, and not, as has been assumed above, 3 per cent.; and if the masses be dealt with, there will be expenses of management to be provided for, and, may be, occasional losses and bad debts. With the most careful calculation it would, from their nature, be difficult to equilibriate these items with mathematical precision. Then, too, it would not be prudent to trust too implicitly to the correctness of the tables. Life assurance societies existing for the purpose of provident and not risky investment, and the ability to meet the death claims made on them being of the first importance, it is desirable and usual that these fluctuating items should be more than covered, and this is done by the premiums actually asked being greater than calculation may show to be absolutely necessary. The result is that the boys and men in our example would have to pay (say) 25s. instead of 20s. a year. The profit made by premiums being excessive is divided every few years,—in a mutual office among the assured, in an office having proprietors, among the proprietors and the assured. In a mutual office, therefore, the assured are not hurt by excessive premiums, the excess being returned with interest. But in an office having proprietors the assured will be affected by excessive premiums in proportion to the amount of the profits to which the shareholders are, by the constitution of the office, entitled; and in either office the assured would be affected if the division of the profits among them—the distribution of "bonus" as it is called—is not equitable. If, for instance, it is so arranged as in effect to rob the younger lives to make the older policies more valuable than they ought to be.

Aurora, Ill., and Ogden, Utah, are, learns the *Electrical Review*, lighted by electric lamps, the power used being that of waterfalls. An electric lighting company proposes to utilise the power of the Genesee Falls at Rochester, N.Y., and is putting in turbine wheels for the purpose.

Reviews.

HOW TO SEE.*

By Richard A. Proctor.

A FEW months since I met, for the first time, the great and genial philosopher Professor Fiske, of Boston, Mass. He was so wonderfully cheerful, that I felt disposed to ask a question akin to that asked in a well-known Bab Ballad, of the Gentle Pieman,

"Why so very very merry,
Is it purity of conscience, or your one-and-seven sherry?"

I refrained, however; and he presently explained. "I have been revelling this morning," he said, "in a new pair of spectacles:" which struck me as almost as odd as revelling in one-and-seven sherry, till he explained that for years he had been troubled by ill-suited spectacles, and that "our friend Mr. Browning" had at a first trial provided him with a perfect pair.

In the book before us, Mr. Browning shows how he manages thus to correct imperfect vision, nay, how cases more difficult than Professor Fiske's can be satisfactorily dealt with. (He mentions that particular case at pp. 62, 63.) The book is full also of useful hints and suggestions about the eyesight generally. He points out, truly enough, that sight, the most precious of our senses (for if we have sight we can both speak and listen, even though deaf and dumb), is allowed to become impaired and all but lost before skilled advice is sought for, whereas for the least defect of hearing a surgeon is consulted.

Although a portion of the work appeared in these columns, the greater part is new—and we believe readers of Knowledge would have been glad to get the work even if it had only contained what appeared here, so useful was the information there brought together.

I am myself particularly interested by what Mr. Browning says respecting his way of dealing with eyes of unequal focal length. My left eye is simply useless for distant objects, though of marvellously sharp vision for objects close by. My right eye is of the usual average focal length. I can fully confirm the statement of one who consulted Mr. Browning about such disparity of vision, that spectacles abruptly correcting it cannot be worn without distress for more than a few minutes. How Mr. Browning worked up to a satisfactory solution of the problem—is it not recorded in the book before us? I shall certainly try this way of doing what all my life I have failed to do—to see, namely, with both eyes at once.

Every one who cares about his eyesight should get this little book: those who think their eyesight of no particular moment can very readily dispense with it.

NATURE'S ENERGY.†

This is at once a very useful and a highly interesting little work, holding a place midway between such works as in former times Neil Arnott and Dionysius Lardner wrote about physical matters, and the technical and, to say the truth, rather dry treatises in which the same subjects have been discussed by some of our modern physicists. Mr. Carpenter, son of one of the most eminent men of science

* "How to Use our Eyes." By John Browning, F.R.A.S. (Messrs. Chatto & Windus, London.)

† "Energy in Nature: a course of six lectures upon the Forces of Nature and their mutual relations, delivered under the auspices of the Gilchrist Educational Trust. By W. L. Carpenter. (Messrs. Cassell & Co., London.)

of the day, has had experience, in lecturing, of the requirements of the general public, not necessarily less instructed all round than those who undertake to teach, but needing clear and simple information, free from technical details, respecting the leading truths of special branches of science, with which the teacher has made himself familiar. There is no greater mistake, we are convinced, than is made by those lecturers and writers who regard their audiences or readers as ignorant persons to be addressed in condescending tone and with childish words. Clearness and simplicity are all that the teacher needs to go straight to the understanding of his audience. Expressed clearly and simply the grandest truths of science while they lose nothing of their impressiveness become acceptable to every reasoning being—a term which does not include those who are so enamoured of a special subject as to have no room in their minds for other matters.

Mr. Carpenter's subject is "Energy in Nature" in all its varied manifestations,—as Heat and as Mechanical Energy, as Light, as Magnetism, as Animal and Vegetable Energy, as Gravitation, as Cohesion or as Radiant Energy.

In the first lecture our author discusses matter and motion, force and energy. In this lecture a very clear and succinct account is given of the laws of motion; but we must take some exception to the remark that "although a body may be apparently at rest, it may have a very decided *tendency* to move," as likely to be misapprehended. A condition of readiness to respond to any application of force can hardly be called a tendency to move. The case cited by Mr. Carpenter, of two weights carefully balanced and then moved with a slight addition to either, indicates no tendency to move: the velocity acquired by the total moving mass at the end of any given time is precisely that resulting from the downward tendency of the added mass, applied to the total mass moved, less such effect of frictional resistance as may be excited during the motion. If the small moving weight may be neglected as compared with the large balanced weight, then when these are doubled, trebled, quadrupled, &c., the resulting velocity is reduced to one-half, one-third, one-fourth. A weight of 2 lb. hung by a long fine thread *begins* to move more readily under slight side pressure than two balanced weights of 1 lb. each,—but because it is freer to move, not because of greater or less tendency to move. This, however, is but a slight defect in a very interesting chapter. The chapter on Heat gives a very complete and interesting account of all the principal facts to be noted in connection with heat regarded as a form of energy. Here again we pass over all the excellent descriptions and explanations, to touch on a passage which seems likely to mislead,—with no unfairness however of intention, but rather dwelling on the fact that the point seems the only one which needs correction; the rest of the chapter can take care of itself. Mr. Carpenter says that radiant heat and light are not identical though propagated in the same way: the waves which affect the sense of touch as heat are much longer than those which affect the eye as light. This, of course, is not strictly correct. There are rays which affect the sense of touch as heat and affect the sense of sight as light. To such rays glass which is opaque to obscure heat rays is as we know not opaque; while iodine in solution, which is absolutely opaque to light, is as absolutely opaque to heat waves of this kind. The more correct way of putting the matter would have been to say that waves between certain limits of length affect the sense of sight as light; and that while the shorter of these waves do not affect the sense of touch as heat the longer ones do, while longer waves still, though not affecting the sense of sight, affect the sense of touch as heat in a still more marked degree than even the longer light.

We note also by the way that the statement at the foot of p. 42, to the effect that "there is good reason for believing that oceanic circulation is due rather to polar cold than to equatorial heat" seems open to serious question. To us it seems like saying that the processes attributed to the sun's heat are really due to the cold following his absence from the sky.

The chapters on Chemical Attraction (including combustion), Electricity and Chemical Action, and Magnetism and Electricity are full of interesting matter. But the most interesting and valuable chapter of all is, in our judgment, the sixth, on Energy in Organic Nature. The comparison between the animal body as a machine (p. 189) and the very best forms of steam-engines as earlier described at p. 54 is worthy of the most careful study. The discussion of the value of various forms of food, though necessarily brief, is excellent. We may say of this chapter that while not one man in a thousand can afford to be ignorant of the facts here dealt with, we doubt whether they are really known to one in a million.

THE WAYS OF SOME INDIAN INSECTS, BEASTS, AND BIRDS.*

This is a delightful book, irresistibly funny in description and illustration, but full of genuine science too. The fun which E. H. A. finds in the ways of insects, beasts, and birds belongs in truth to the poetry of this part of science, as certainly as the solemn mystery of the star-depths belongs to the poetry of astronomy. And as the fun of our author is full of poetry so does it verge now and then on the terrible or the pathetic. How humorously he describes the microphonic ears and the distant-smelling nasal appendages of the demon bat; but we are more disposed to shiver than to smile when he goes on to show how this deadly creature hears and scents its prey. "Those ears are fit to catch the gentlest rustle of the feathers of a dreaming sparrow," its nasal trumpets "gather the faintest odour of the sleeping prey as the demon bat floats past upon the air." "It scents a sparrow asleep with its head cosily buried in its wing. The sparrow has a dream, a dreadful dream; it starts and raises it head and gives a piercing shriek and the curtain falls——In the morning two wings are lying beside the flower-vase upon the table, and perhaps a beak, though the demon bat eats head, skull and all, before any other part."

Take again what E. H. A. says about lizards:—They "once were great, the aristocracy of the earth. What a strange world there must have been on this same earth of ours in those days! Did mosquitoes as large as sparrows, with voices like tin trumpets, infest the swampy wastes and torment the drowsy *megalosaurus;* and did the winged lizards, like flying foxes, hawk them in the dusky forests? Did the mild *iguanodon*, when it had done browsing on a tuft of maidenhair fern about the size say of a clump of bamboos, turn round and waddle away into a hole, as its successors do to-day on the plains of Guzerat? The lizards are the wrecks of a great past. They had their day; perhaps they abused it: at any rate the great unresting wheel has gone round, and that which was up is down. The commonalty do not seem to feel it much. But all the descendants of great families, the crocodiles and alligators, and even iguanas, are a prey to melancholy. They maintain a dignified spiritlessness which is affecting." "Like

* "Tribes on my Frontier: An Indian Naturalist's Foreign Policy." By E. H. A., with illustrations by F. C. Macrae.

all races whose greatness is a memory, lizards are sensual, passionate, and cruel" — Passionate! "Two sparrows will squabble and scuffle, until they get so inextricably mixed that, when they separate, it is quite an open question whether they have got their own legs and wings or each other's; and two ants will fight until they die in each other's jaws, and a third come up and carries off the whole jumble for the food of the community; but for an example of devouring rage go to the big garden lizard, which the children in India call a bloodsucker. See it standing in the middle of the road, its whole face and throat crimson with wrath, and swollen to the bursting point with pent-up choler, its eyebrows raised and its odious head bobbing up and down in menace of vengeance. And the explanation of the whole matter is that another smaller lizard snapped up an ant on which it had set its heart. Nothing will appease it now but to bite off the offender's tail. This will do the latter no harm, for a lizard's tail is a contrivance for the saving of its life, planned on exactly the same principle as the faithful Russian slave, who threw himself to the wolves that were pursuing his master's sledge. I once saw a fierce scorpion catch a lizard by the tail and plunge its sting into the wriggling member; but before the venom could circulate to the lizard's body it detached its tail and ran away grinning." The illustration is splendid: the lizard is grinning indeed, and conscious of the humorous aspect of the matter; yet can a lurking feeling be detected that on the whole he would rather have kept the tail if he could have done it safely. "The scorpion went on killing the old tail, and the lizard began growing a new one."

The migrations of the *Callidryas* (Butterfly so named by E. H. A.) give an interesting illustration of Mr. Wallace's theory that migratory instincts are among Nature's devices for keeping down surplus populations. When once set a-going, the Callidryas keep going. With scarce a pause to rest their wings or sip a flower, from eight or nine o'clock until the afternoon, as far as eye could reach, the host kept streaming past like the fugitive Gauls after one of Cæsar's great battles. And in their fate, too, they resembled those barbarian hordes, when a deep river at last barred their weary way, and they tumbled headlong, one upon another, into its reddening waters; for I stood again another year beside the Bombay harbour, and watched the frenzied myriads hurrying from the mainland over Elephanta, and across the sea and over Bombay or Karinja—for their direction was southerly—and *then?* Then I suppose, over the sea, and on and on and on and on, until darkness settling down on them, and their amazing strength at last ebbing away, they must have dropped into the waves, each one, as it fell, creating and perishing in a small South Sea Bubble of its own; and the fishes had a feasting to be remembered.

E. H. A. is not altogether a follower of Darwin. Speaking of the mosquito, he says: "Huxley has abolished teleology, and Darwin has proved to the satisfaction of every one who is disposed to agree with him, that no characteristic in any animal can be explained by its being beneficial to some other animal" (he is referring here to a theory of his own, started earlier by Mr. W. Mattieu Williams, that the mosquito was designed "to promote a healthful use of Nature's currycomb among a class of people too much accustomed to regard water only as a means of quenching thirst"). "Only those peculiarities," according to Darwin, "are maintained and developed which are advantageous in some way to the animal itself, and give it a pull over others in the struggle for existence. And so we are plunged in a mire of perplexity. For what possible gain can it be to a mosquito to gorge itself in my life-blood until its wings almost refuse to carry it and it can just sail slowly, like some great crimson balloon, with the wind, positively inviting me to imbrue my hands in my own blood. Insects require no food in their winged state—at least the flimsier kinds do not, such as flies, gnats, and butterflies. They have done all the serious business of life, the eating and growing, in their grub state, and when they dress up and come out into the world to enjoy a few days of vanity before they die, they have no proper mouths, only a sort of tube for sipping light refreshments. But supposing mosquitoes do require nourishing food—why can they not bleed us painlessly? Why make us pay fees of anguish for the operation? The traveller who invented the vampire bat understood matters better, and made the horrid monster fan its victim gently with its ample wings," . . . and so forth, till finally E. H. A. tells us he holds "that Darwin weighed in the balance against the mosquito is found wanting."

Very quaint yet very suggestive of close observation is E. H. A.'s remark that "if there is a scrap of truth in the development theory, the crow's way of examining everything with one eye must certainly bring on an eyeglass in time." Bring on an eyeglass!

But we have marked so many passages for quotation and comment that four or five numbers of Knowledge would be required to present them all. We must content ourselves with the remark that there is not a dull or uninstructive page in the whole book.

Thunderstorm at Bournemouth. — A very severe thunderstorm passed over Bournemouth recently, the lightning striking the chimneys of Little Forest House on the East Cliff. The house was not occupied at the time, and the fire was therefore not immediately discovered. The building was burnt to the ground. Some valuable pictures were saved by the fire-brigade, but the remainder of the property, worth several thousand pounds, was destroyed.

Accidents from Lightning at Cyprus.—On October 31, during a violent thunderstorm, a native who was riding near the village of Archa was struck by lightning, and he and the mare he was riding were both killed. On the same day a woman and an ox were struck dead by lightning at Sotira; and near the same village, on the following morning, a man and a mare he had been riding were found dead, having been struck down by the electric fluid.—*Cyprus Herald.*

The Telephone during the Java Earthquake.—While the eruptions of the volcano Krakatoa and the shocks at Java were proceeding, it was impossible to use the telephones at Singapore, in consequence of the noise in the wires. The sound was like that of a distant waterfall. On one line, part of which was submarine, detonations like pistol-shots were heard.

The Victor Emmanuel Gallery.—The covered street at Milan, now well known under this name, is roofed with glass, and completed by a large dome, round the interior of which runs a chain of gas-lamps. The lighting of these lamps at a considerable elevation used to present some difficulties, and was always a source of risk, until an arrangement was made for doing the work by electricity. A miniature railway has been constructed close to the gas-burners, on which runs a little electric locomotive carrying a wick steeped in spirits of wine. When it is desired to light the burners, this wick is set on fire, and the locomotive started on its career. It flies round, rapidly kindling the circle, and exciting great interest among the crowds that assemble nightly to witness the performance.—*Engineering.*

THE EARTH-FLATTENER'S CHALLENGE.

By Richard A. Proctor.

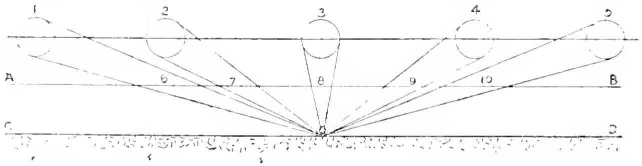
A LETTER from the Zetetic Society points out (1) that Parallax claims to have seen, not the structure of a bridge, but a boat (through a telescope), six miles away, his eye being close to the water's edge: his law of perspective, though inconsistent with the laws of nature and observed facts, is not inconsistent, it seems, "with *this* fact." I dare say not. The impossible things seen by Parallax are doubtless quite consistent with his imaginary law. But to one who like myself has swum in lakes and rivers in all parts of the world, and in seas as still as the calmest lake, it is well known that what Parallax claims to have seen he never did see. True, I have not swum with "a good telescope" at my eye; but I have seen objects in the water with perfect distinctness to the water's edge at a mile's distance when my eyes have been six or seven inches above the water; so that when I have seen the water line rise up and hide those objects as my eyes have approached the water level, I have known that no new law of perspective, but the water's rotundity concealed them.

would indeed have been an astounding observation if 23° south latitude had been in question. But I would invite the Zetetic Society (before they accept their many-named founder at his own valuation) to observe that he manifestly spoke falsely over this matter, since the ship in question—no flyer—reached Southampton at a date mentioned in the report, and she would have had to fly indeed to have reached that port from 23° south in the time shown; whereas from 23° north, some 3,200 miles nearer, the journey was very comfortably accomplished.

The Zetetic Society then proffers an explanation of my first problem, an explanation which is so far from even any pretence at validity that at first I was disposed to regard it as a joke. Having satisfied myself that it is *not* so meant, I give it, not to amuse readers (though it will) but to show the utter hopelessness of any attempt to set right persons who can be deceived by such ludicrous pretence of reasoning.

QUERY.—Why, despite the enormously varying distance of the sun (while yet it is day) according to their theory, the sun does not vary correspondingly in apparent size.

"His size does vary, as everybody knows, mostly in rising and setting, and quite in accordance with the theory of *flatness*, and on the principle that a luminous body of a given diameter does not subtend the same angle as a non-luminous body of the same magnitude and at the same distance. The diagram will show also that, as the sun recedes from the meridian, over a plane surface, the light, as it strikes the atmosphere, must give a larger disc."



"Let A, B, represent the upper stratum of the atmosphere; C, D, the surface of the earth; and 1, 2, 3, 4, 5, the sun in his morning, forenoon, noon, afternoon, and evening positions. It is evident that when he is in the position 1, the disc of light projected upon the atmosphere at 6, is considerably larger that the disc projected from the forenoon position, 2, upon the atmosphere at 7; and the disc at 7 is larger than that formed at 8, when the sun, at 3, is on the meridian; when at 4, the disc at 9 is again larger; and when at 5, or in the evening, the disc at 10 is again as large as at 6, or in the morning position. It is evident that the above results are what must of necessity occur if the sun's path, the line of atmosphere, and the earth's surface, are parallel and horizontal lines. That such results do constantly occur is a matter of everyday observation; and we may logically deduce from it a striking argument against the rotundity of the earth, and in favour of the contrary conclusion, that it is horizontal. The atmosphere surrounding a globe would not permit of anything like the same degree of enlargement of the sun when rising and setting, as we daily see in nature."

"With regard to the remaining three questions," proceeds the representative of the Zetetic Society, "we do not think they have any bearing on the subject. Parallax and his followers do not pretend to solve all the problems so as to reconcile them with his doctrine. It has taken nearly three centuries to reconcile certain phenomena with the theory of rotundity, and scores of them still remain unreconcilable. We do not doubt that in time all such questions will be solved each in its turn, so long as the premises are based on data which are capable of being tested and demonstrated in accordance with *facts* and *truth*."—H. Ossipoff Wolfson, Secretary, Zetetic Society of Great Britain.

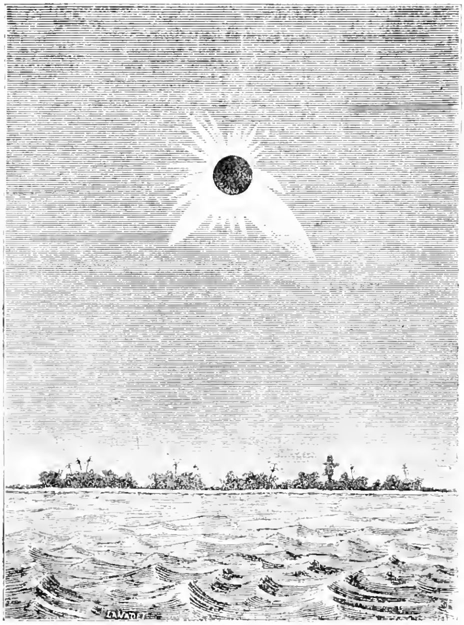
The Zetetic Society invites me to repeat Parallax's experiment of firing a gun tied vertically, to see whether it is or is not utterly incredible that two shots out of fifty might fall back into the muzzle of the gun. I utterly decline. If I missed killing myself, I should probably kill someone else: I may very literally say therefore, "I'll be hanged if I do." Considering, however, that thousands of experiments on falling bodies show that with the most delicate appliances to avoid disturbance, bodies let fall within places carefully shielded from the external air have not in a single instance fallen either,—exactly in the calculated place, or exactly below the point of suspension, or any two in precisely the same place, I must be excused for utterly declining to believe that two balls out of fifty *fired* from a gun *tied vertically*, fell back into the muzzle. I should have been quite sure independently of this statement that Parallax would not stick at a trifle in the way of invention; but if he had before been known to me as the original Unclothed Dweller in a Well I should still have unhesitatingly rejected this story.

With reference to the *Times'* note in which mention was made of the Pole Star being seen from latitude 23°, the representative of the Zetetic Society thinks it must have been south latitude, because the North Pole is always above the horizon in 23 N., "and the *Times* being a carefully informed and well written paper, we must infer that south latitude was meant." The inference is an odd one. The passage occurred under head "Naval and Military Intelligence," and related to a war-ship or transport-ship whose return was announced. It merely meant that on such and such a day, a latitude observation of the Pole Star showed the ship to have been in latitude 23°, not that on that day the astounding observation was made that the Pole Star was visible from latitude 23°: though that

I propose to wait, all the same, until the Society is good enough to explain why when their system puts the sun at certain times in certain positions, he *shows himself* in quite other positions. These questions may have no bearing on the Zetetic theory: for they are reasonable and the theory is not. But the Zetetists must be content to wait for further notice till they have a reasonable theory.

THE ECLIPSE OF LAST MAY.

WE give this week a most interesting picture of the solar corona as drawn by M. Trouvelot during the eclipse of last May. M. Janssen's report mentions that all the forms shown in the picture were seen with singular distinctness. The eclipse is remarkable for the success with which Janssen examined the spectrum of the corona for the Fraunhofer dark lines of which he placed about a hundred, showing clearly that the corona's light is in part reflected sunlight. M. Tacchini detected in the spectrum of the great coronal plume the bands shown in the well-known spectrum of comets. It need hardly be said that



M. Janssen mentions only to dismiss with a smile Dr. Hasting's notion that because signs of the effects of diffraction can be detected in the corona, therefore the corona is wholly a phenomenon of diffraction.

Editorial Gossip.

I FIND so much that is really scientific, as well as amusing, in Mr. Trotter's poem that I have inserted it as it stood. I had occasion to make a little note upon one part of it, and as I found a prose note had a comical effect I ran the note (with as little change as possible) into rhymed form.

OVERHEAD WIRES.—The agitation against overhead wires has lately received some support from the risks incurred by firemen and spectators during the progress of fires. While the great Glasgow fire was raging, a considerable number of wires came down, and at Nottingham, last week, the fire which destroyed the large oil-mill melted the wires crossing the burning premises.

TIME TURNED BACK.*

BRING out Imagination, and we'll put her to the Car,
And harness fitful Fancy, for to-day we travel far,
Due northwards our direction, and through chilly gloomy Space,
One hundred and six five billion miles,† and at a rattling pace.

* * * * *

Now stop, and turn our telescope towards the distant Earth,
And we shall shortly see how much our expedition's worth.
We've found it: now bring England to the middle of the field;
Slip on a higher power that will good definition yield.
Here's a quiet Hampshire village, that we've never seen before,
And 'tis as though we stood before a lowly cottage door;
And peeping through the lattice, there's an aged woman sitting
In an arm-chair by the fireside, feebly toiling at her knitting.
Who's this weather-beaten soldier bursting through the cottage door?
'Tis her son—and see, she knows his footstep on the sanded floor—
Just back from the Crimea: no more battles, night alarms,
No more hardships and privations.

* * * * *

Leave him in his mother's arms
And away again at twice the speed of light—'tis quickly reckoned,
You'll find 'tis‡ nigh three seven three thousand miles through Space per second.

* * * * *

Now through the cottage window there's a sight that makes one glad,
As the thankful mother kisses the brown cheeks of her dear lad.
But see, the two are separatin,g and with outstretchèd arm
The good old lady sinks into her chair, and with a calm
And unexcited manner, in the firelight gently rocking,
Is quietly at work, but is unpicking her new stocking.
The soldier striding backwards, his strong arms are still stretched out—
Backs through the door which opens of itself to let him out.
A last glance within the window shows us plainly, if we wait,
We shall see the soldier's mother, who now wipes a pewter-plate,
Engaged at supper; but the sight would surely turn us pale,
So over the description, we had better draw a veil.
The soldier backs along the road—to him it's not surprising
That in the glowing western sky the evening sun is rising,
And that the busy village mill, with never-ceasing clack,
Makes grain from flour, and with the wheel it laps the mill-stream back.
And that the reeds in yonder brook, where gurgling eddies gleam,
Nodding their heads, bend forward low against the rapid stream.

* * * * *

* Suggested by "The Stars and the Earth."
† 165,000,000,000,000 ($=165 \times 10^{12}$). ‡ 372,800.

We'll hasten onward from the Earth, for Fancy knows no limits,
The story of the previous weeks whirls by in a few minutes.*
Now past Gibraltar, Malta, Greece, the ships sternforemost skim:
Whoa! slacken speed to former rate, for see, the air grows dim,
And muskets flash, and cannon blaze, the battle's all around,
But as we have no telephone there's not the slightest sound.
The movements are confusing 'twill be better if you please;
To travel at a slower rate, and see things at our ease.
Our soldier is a gunner, and he ought to think it fun,
For here the clouds of smoke grow thicker, rolling t'wards the gun;
They gather at the muzzle, now, and with a blinding blaze,
The shot comes up and drives them down the barrel as we gaze.
An officer unwriting a dispatch, by "Raglan" signed,
The pencil gliding to the right leaves paper clean behind.
The battle, as we've hinted, does not seem so very sad,
For the dead on all sides rise up, although many wounds are bad;
And now the bullets quit their bodies, leaving unharmed skin,
And finding their respective muskets, with a flash go in.
The cartridge-cases fill, and soon the cannonadings cease,
The troops march backwards to their camps, and all again is peace.
Now home again, lest some fixed star's attraction should allure us,
For now we're more than twice as far from Earth as is Arcturus.

* * * * *

At first it seems impossible to witness bygone scenes,
But it is not unthinkable to us by any means;
The laws of Physics on this Earth, we cannot but obey:
This does not contradict the laws of Thought in any way.

A. P. T.

The *Railway Review* (Chicago, October 6) copies from the Pittsburgh *Dispatch* an account of the tunnel lately completed, under part of the city, for the Pittsburg, McKeesport, and Youghiogeny Railway. The ground was covered with buildings and piles of metal, &c.; it was chiefly composed of cinder, and intersected with sewers and pumping mains connecting the river with numerous works. Thousands of tons of metal, ore, sand, &c., had to be moved for the purposes of the survey; and when the works were begun, every foot of the way had to be shored up, for the protection of the workmen from the loose, cindery soil. All difficulties were, however, overcome, and the tunnel, 165 ft. long and 18 ft. high, was completed in a few days over a year, with only the loss of a single life.

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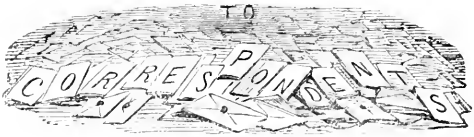
* Just here I would throw in a note suggested by this poem
(On things that we can surmise, though perchance we never know 'em).
This voyager in space, as our deponent seems to say,
Saw more than had elapsed within the compass of a day;
But all that time the earth was swiftly turning without jars,
And the places seen from far away were turned tow'rds diff'rent stars.
So to see those places clearly during several days' expiral,
Our trav'ller must have voyaged in a most amazing spiral.
See this subject lightly touched on in my cheerful little treatise,
Called "Geometry of Cycloids," which for seaside reading meet is
(It's advertis'd, I notice, in the outside sheets of Knowledge,
But the bulk of it I worked out in my "salad days" at College).

R. P.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

THE EXTRAORDINARY SUNSETS.

[1039]—I have just read Mr. Ranyard's communication in this day's Knowledge on the above subject, and find that he has arrived at the same theoretical conclusion as myself. To test its soundness, I placed some strips of glass in an exposed position, and examined the dust deposited thereon in order to ascertain whether it included any evidence of meteoric iron. The results have been equivocal. I found traces of iron, but until the last few days the wind has blown from the south and south-west, and thus has brought me so much London smoke that no reliance may be placed on such traces. The snowfall of Wednesday and yesterday has, however, come to the rescue. The wind that brought it is from the north and north-west, which reaches me after crossing the Weald of Harrow, and that curious district around, which, though so near to London, is one of the most thinly-peopled parts of England. The virgin snow carefully collected from my garden at a distance of 80 yards from my chimnies, and about half a mile from any to windward, is thus a fair sample.

On thawing some of this that had been collected by slicing off the top film of the snow with a piece of glass, I found a sediment of fine brownish-black powder. Ferrocyanide of potassium added to the snow-water produced no change of colour, showing the absence of iron in solution there, nor was there any visible reaction on the black dust until I added some hydrochloric or nitric acid. Then the characteristic blue compound indicating iron was abundantly formed all around the granules, and presently, as their solution was effected, a bluish-green deposit was formed, and the whole liquid deeply tinged with the same. It was not the true Prussian-blue reaction of iron alone, but just the colour that would be produced by mixing small quantities of the cyanide of nickel (yellowish green), with a preponderating amount of Prussian blue.

I have posted to Mr. Ranyard the precipitate obtained from 1½ oz. of snow, and he will probably be surprised—as I was—at its quantity. There is no doubt about the iron, but the nickel demands further investigation before its presence is demonstrated. The green tinge is merely suggestive. If it is really there, the evidence of cosmical origin of the material brought down by the snow will be overwhelming.

The iron appears to be in the condition of magnetic oxide. The particles that I have examined in the microscope do not display the pear-shape which has been described as characteristic of meteoric dust. They are more like agglomerations of minute spherules, and with them are the usual crystalline and organic particles found in dust. Never having examined unquestionable meteoric granules I am unable to speak with any confidence concerning the microscopic evidence afforded by these. W. Mattieu Williams.

Stonebridge-park, *Dec.* 7, 1883.

[1040]—I think that I can give categorical replies to two of the questions suggested by Mr. Ranyard's very interesting article on p. 341. The first snow fell here (very slightly) on the 5th, followed by a much heavier fall on the night of the 6th and the morning of the 7th. The sunset on the latter evening was a tolerably fine one, but the astonishing after-glow of the preceding one was no longer visible. I have examined the deposit from about a gallon of snow carefully collected, and find under the microscope that it is full of

particles of iron, easily separable by a magnet from the organic dust (of which, by-the-bye, there is very little) accompanying it. The wonderful crimson of the sky here on the nights of the 4th and 5th were accompanied by the beautiful spectacle of a Green Moon. My own idea was that this was simply a retinal effect of contrast; but that very accurate and painstaking observer, Mr. H. Pratt, F.R.A.S., of Brighton, seems to have examined the moon with a two-inch achromatic telescope, so as to cut off all the light of the sky, with the result that he "found the bluish-green tint of the moon more decided and beautiful than before." This would seem to point to the dichroism of the reflecting medium—whatever it may be—to which we are indebted for the recent gorgeous phenomena. I may add that my butler tells me that this morning's sunrise was similar to some of the recent abnormal ones; but I did not see it myself.

Forest Lodge, Maresfield, Uckfield, WILLIAM NOBLE.
Dec. 10, 1883.

LUNAR SHADOWS.—STRANGE SUNRISE AND SUNSET EFFECTS IN LANCASHIRE.

[1041]—I read with interest the Rev. J. W. Webb's article in KNOWLEDGE, of Nov. 16th, on "Lunar Delineation"; but he seems to me wrong in saying that the "shadows are of unbroken blackness," owing to the want of a "reflective atmosphere," and that the facility of delineation would therefore be increased! If such were the case, a moon-picture would indeed be a simple affair—nothing but fields of light surrounded by utter blackness. Now, one reason a moon-picture would be worth doing is that, although the sky or space behind the mountains would be absolutely black, there is no reason why the shadows in the mountains should be so; on the contrary, they might be full of bright reflections from the intense glare on the exposed parts of rock, and—as the Rev. J. W. Webb well knows—a moment might be chosen when only the highest peaks catch the sun's light, so that the rest of the rocks and foreground might be without any sharp shadows at all. I don't understand why he uses the words "reflective atmosphere." Isn't it enough to say that the moon is without atmosphere?

At Coniston we have had wonderful effects over the lake. I have been in the habit of watching the sky all my life, being a sea and sky painter, but have never seen such extraordinary effects. One morning, Coniston Old Man (2,600 feet), was quite red, and this before sunrise, when it was almost dark. It never lost its light, but there were no shadows until nine o'clock, when, I suppose, the sun's real light began to reach it. The other evening at a quarter to five, we had cast shadows from the intense glare of illuminated vapour above the sunset, and the crescent moon to the left looking pale blue. ARTHUR SEVERN.

[I have ventured to add to Mr. Severn's letter on Lunar Delineation, a portion of the letter accompanying it, which (as a whole) was not intended for publication.—R. P.]

THE ERUPTION IN THE SUNDA STRAITS.

[1042]—Ceylon has been more or less affected by the volcanic eruption in the Straits of Sunda. Penang also, which is 800 miles off, heard the noise plainly. We are 1,600 miles. I heard the noise as of distant artillery. We had in Colombo, at Guler, and at Point Pedro—west, south, and north of our island—a tidal-wave first to recede, then to advance. At Cape Comorin, south point of India, this extended to half a mile. We presume the agitation of submarine forces was extensive, and had for its centre an island in the Straits of Sunda, which had been silent for 200 years.

A concurrent phenomenon has been the aspect of the sun before setting. He has, from olive green, become pale sea-green, and anon the appearance of a pale full moon, so that the large spot at the left, rather above midway, could be seen without difficulty, as we could gaze at him without the necessity for coloured glass.

The interesting point is whether this green is from the sun's gases, or whether from atmospheric causes around this portion of the earth. I should be glad to know whether during the past week—say back from Sept. 11 inclusive—the sun bore the green aspect in England. Certainly I never saw the sun green before. The weather of late has been abnormal—very dense, white, and leaden-coloured clouds.

If the sun was not green elsewhere—in England, for instance—then we must conclude it is from purely local atmospheric causes hereabouts. If he has looked green at home and elsewhere, then the question reduces itself to whether it has been caused by the earth's unusual atmosphere or from the solar disturbance.

Colombe, Ceylon, *Sept.* 13, 1883. H. L.

GREAT SEA-WAVE.

[1043]—On Aug. 27 the inhabitants of the seashore were thrown into consternation by seeing at about 1.30 the sea suddenly recede, leaving in some places reefs and foreshore dry, and then as suddenly rising to an unusual height half-an-hour afterwards. This continued at intervals all the afternoon, casting boats adrift, stranding them and a lot of fish which were caught napping, and were then promptly picked up by the aborigines. Beyond this no mischief was done here. Most people attributed it to volcanic action (for we are not altogether strangers to these matters, and, indeed, keep an active volcano of our own at Bourbon), and a good many people felt a slight shock. I did not. Probably the shocks would have been more generally felt had they occurred in the evening, or at a time when most people are quiet. We had, however, no idea at the time that the origin of what we saw was so distant, and that we were feeling only the *contre-coup* of the fearful catastrophe of the Sunda Straits. Little by little, news has been received from every part of the Indian Ocean, and it would appear that even as far as the African coast the wave extended. At Tamatave, a friend of mine was sitting with several people on the beach, when, to their amazement, they saw the sea recede so much that the French men-of-war which had just bombarded the place were all but stranded. This was at 3.30. With us the first wave was at 1.30.

It would seem that there is a renewal of volcanic activity in many parts of the world; and of late the light of Bourbon volcano has at times been seen from here at night.

I can hardly see how the things are related, but it is certain that about that time we were favoured with a series of the most extraordinary sunsets and sunrises that I ever witnessed, even here, where we are famous for them. Our Astronomer Royal gives a lame sort of explanation about the passage of light through volcanic dust, but none of that has been seen here. At Seychelles the same phenomena are reported, and there the sun rose in the wrong place one fine morning, and did not get right again till some time late in the morning. [This must refer to abnormal sunlight, not to sun's disc.—R. P.]

If our sunsets had happened in the hurricane season we should have known what to expect, which would have been what the sailors call "beans" (refer to Mr. M.), but in August and September there is no excuse for them.

One sunset in particular I remember. If Turner had painted it, it would have been said that on that day he was either delirious or drunk. I was coming into town one evening by train, at about 5.30 to 5.45 (you are for ten minutes or so in view of the setting sun and a wide stretch of ocean). That evening the sea was a bath of mercury, or molten lead, streaked with black. The sun, but a few degrees above the horizon, was a yellow, blurred opening in the haze; the sky was one mass of streamers of every colour, and what ought to have been blue was leaf-green; the air was orange-colour, and everything was as though seen through a glass of that colour. This strange sight terminated by a performance which is rare in ordinary times, but has frequently appeared of late. The sun sets, and it seems as though night were coming on more rapidly than usual, when, behold! the whole concern lights up again, and it becomes lighter than before. The sun sets, but the light is ghastly and ill-conditioned; ten minutes afterwards all is dark. In the morning the reverse happens. Long before sunrise, the sickly yellow light suddenly glares upon us, making the sky as a grass-plot, and all things hideous; this lasts fifteen minutes, and comparative darkness sets in; then the sun rises as it should. What connection has this with volcanoes? Query. Can you answer?

Port Louis, Mauritius. A CORRESPONDENT.

MOON'S MOTIONS.

[1044]—The nearer any body is to the sun, the more light it will receive, therefore the brighter it will shine, and will appear brighter to an observer on a neighbouring body.

(1.) During a complete revolution of the moon, with respect to the earth, she will vary her distance from the sun about half a million miles. (2.) By the earth's revolution round the sun, the moon is in winter brought three million miles nearer at that time than in summer. So that, viewing the full moon in December, should it not be brighter and larger than the full moon in June, seeing that it is three million miles nearer to the source of light?

Being a science teacher, I have lately been giving lessons on the "Moon," and have endeavoured to explain the longer moonlight of winter than of summer, greater height in heavens, &c., and was struck with the idea mentioned above. I have not seen it mentioned in any text-book I possess.

Another matter I should like to ask your opinion about, and that is—"We may get an idea of its (the moon's) motion round the sun, if we imagine a wheel going along a road to have a pencil fixed

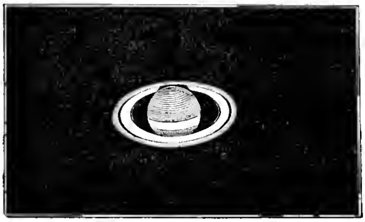
to one of its spokes, so as to leave a trace on a wall: such a trace would consist of a series of curves with their *concave* sides downwards, and such is the moon's path with regard to the sun."—"Elementary Lessons in Astronomy," Lockyer, p. 90.

I had the pleasure of hearing your lecture on the Moon, at Kensington, and noted your effective diagrams on the same subject; and, of course, was puzzled, when I remembered what Mr. Lockyer had said. SCIENCE TEACHER.

[The moon will appear brighter by about one-fifteenth in December—not larger. Of course, the account in extract quoted is quite incorrect.—R. P.]

SATURN.

[1045]—I cannot help thinking "F.R.A.S." will be disappointed with the illustration of Saturn in KNOWLEDGE of Nov. 23. Wood engraving does not lend itself well to the delineation of planetary details. Better, I should say, to have omitted the shading on the ball entirely rather than represent such a bright object so black. Then, again, the rings do not appear satisfactory to me. On looking at the planet the same evening with a good 3¼ O.G., I was so



Saturn, Nov. 23, 1883, 11.45 p.m. (3¼ in. Wray, power 250).

struck with the difference that I took the trouble to make a careful drawing (of which I enclose a tracing), showing exactly what I saw. The "crape ring" was only at times glimpsed in the ansæ, and it was better seen on the left than on the right. The square-shouldered aspect of the shadow on the ring was remarkable, though perhaps I have somewhat exaggerated it in the drawing.

H. H.

LARGE METEOR.

[1046]—The sky being very clear last evening (Nov. 28), I was out in the garden with my telescope, and about 10.35 I was looking in a south-westerly direction searching for 51, Piscium, when suddenly I perceived that something unusual was taking place overhead and somewhat behind me, for the sky had suddenly become brilliantly illuminated from that direction, and on turning my head up to ascertain the cause, there I beheld a great fire-ball or meteor, with a long tail of sparks, gliding across the sky from south to north. The whole apparition did not occupy more than five or six seconds of time, and as it was rather of a startling nature, I had scarcely time or presence of mind to note its path exactly; but, as far as I can say, it was about as follows:—When I first saw the meteor it was near π^2 Orionis, from thence it passed about one degree east of ζ Tauri, and about two degrees west of θ Gemini, across Lynx, and finally disappeared just before reaching v Ursa Majoris. The ball itself was apparently almost as large as the full moon, and the front or leading part of it was of an intense white colour, while the back part, just where the tail commences, was purplish-blue, and the tail or train itself was composed of red sparks, which issued from it in its flight, and gradually died out at a distance of about three or four degrees from the ball. It was a magnificent sight while it lasted, the whole sky being illuminated as if by a lingering flash of lightning, the meteor maintaining its brilliance until it was crossing Lynx, when it there began to fade gradually, and finally disappeared at the point named above, by dying out, apparently without any explosion, and I did not notice any noise accompanying it at all. As regards its distance from the earth, it really appeared to be very near; I might almost say that it did not seem to be above two or three hundred yards from me, and I hope it may have been observed by some one else, at some distance from here, who would be able to give you its apparent path from their point of view, so that you might be enabled to ascertain its actual distance. It resembled in many respects the large meteor I saw on the evening of May 4, 1882, and which I described in a letter (435) in KNOWLEDGE of June 23, 1882.

Huddersfield, *Nov.* 29, 1883. EXCELSIOR.

TRICYCLING IN WINTER.

[1047]—I can endorse Mr. Browning remarks as to the pleasure of going over frozen roads; but be careful to see your lamps are all right, as the oil soon freezes. Can Mr. Browning give us any experience of the Omnicycle? I have no fault to find with mine, but should like to know his views. I also want to know what speed can be attained and kept up on it. I am unable to test this, being very weak. JOHN ALEX. OLLARD.

CONVERTIBLE "SOCIABLES."

[1048]—In answer to E. B., who asks what is the swiftest, safest, and cheapest Convertible Sociable, I do not know any machine which possesses all these good qualities in itself. I should say that the "Cheylesmore" Convertible Sociable, made by the Coventry Machinist Co., is one of the swiftest, and that the "Europa" Convertible Sociable, made by the St. George's Foundry Co., is the safest and cheapest machine I have yet seen. In reply to the second query, I have said very little respecting Convertible Sociables in any of my articles. I think them very inferior to machines that are not convertible generally, but I must except the "Europa" from this criticism—it is as solid in the double form as in the single, but it is more difficult to make the conversion.

JOHN BROWNING.

SHAKESPEARIAN INSECTS.

[1049]—"Letters on the Natural History of the Insects mentioned in Shakespeare's Plays," by Robert Patterson (London, 1838), is in my possession—an interesting but discursive book. The subject well deserves more recent treatment. J. KIRKMAN.

S. Stephen's Vicarage, Hampstead, N.W., *Dec.* 8, 1883.

COALFIELD MEN.

[1050]—Apropos of Mr. Grant Allen's remarks on Anthropometry, the following quotation is interesting. It is from Frank Buckland's "Curiosities of Natural History":—"The geological formation of a district, I found in examining recruits for the regiment, has considerable effect upon the stature of its inhabitants; coal-producing countries as a rule generally grow the tallest, and at the same time, the largest-boned men." DORA HOPE.

ORIGIN OF THE WORD "MASHER."

[1051]—I can trace "Mash" and "Masher" back a good deal further than 1878. The words were in common use in San Francisco as far back as 1875; and in 1876, at Bush-street Theatre, I remember a riddle given by the Minstrels then performing there, "Why are San Francisco ladies like well-boiled potatoes?" with the reply, "Because they are so easily mashed." A reference to the San Francisco *Chronicle* about these years will show that the term "Mashers" was applied to the young men who waited outside theatres to "mash" the ladies leaving there on *matinées*, which, as you know, are held every Saturday afternoon, and are attended largely by ladies. The "dude" in San Francisco was, and is, called "a statue," or "Kearney-street Statue," from their habits of posing themselves on street corners to "mash" the girls.

SAN FRANCISCO.

WEATHER FORECASTS AND HOW TO MAKE THEM.

[1052]—Allow me to correct a slight inaccuracy which I notice in Mr. Browning's otherwise excellent article on "Weather Forecasts," &c. I refer to the word "weeks," in the paragraph in which my name appears; this ought to read "months."

Mr. Browning recommends Grace's Spectroscope to those who experience difficulty in seeing the Rainband with the instrument depicted in Fig. 1., but I think it would be as well to keep as much as possible to one form of spectroscope for meteorological purposes. The latter kind is now being used by hundreds of observers, and to my mind, taking it altogether, is the better of the two for prognosticating weather.

The more I use the "Rainband Spectroscope," and compare its indications with the weather experienced, the more it seems to me that its name is a misnomer. The rainband is not the principal feature in the sky spectrum; there are others of equal importance to take into consideration, *e.g.*, the dry air bands at a and β, the moist-air bands at a and v, &c.

The instrument is essentially a hygroscope and spectroscope combined, and, with these reasons in view, I have ventured to coin a new word for this particular modification of the spectroscope, and would suggest calling it in future "The Hygrospectroscope."

F. W. CORY.

FEEDING CHAMÆLEONS.

[1053]—"H. Smith" should keep his chamæleons in a warm place, and feed them on insects, if procurable; but they are able to live for several months without food of any kind.

LUMINOUS BEETLE.

[1054]—Seeing a correspondent writes you on luminosity of animals, allow me to say that I have seen the same phenomena, not only with centipedes, but also with the common little garden beetle (what his proper name is I do not know), but that I was able to take the fellow home, and had a good examination. The phosphorescent matter adhered to my fingers when I picked him up, and there was an offensive odour connected with it, which I attributed to having been among some decayed matter. I do not know if that would cause it. Fred. F.

PERFORATED STONES OF INDIA.

[1055]—Permit me to answer your correspondent "Cosmopolitan" (No. 1018), in reference to the perforated stones of India and elsewhere.

The fullest information possible can be gained from General Forlong's magnificent work, called "Rivers of Life," published by Quaritch. Vol. II. contains many pages devoted to this subject.

Charles Voysey.

LETTERS RECEIVED AND SHORT ANSWERS.

Student.—Cannot indicate books and prices of books on economic science.—W. Motton. Applications became so numerous that have had long since to withdraw that offer.—T. W. Schaffner. Lines mentioned were not enclosed; but in any case personal characteristics, however estimable, could hardly be referred to in these columns.—H. Clarke. If you skid the wheel the top moves no faster than the bottom; but if you let her run the top point moves twice as fast as the centre and infinitely faster than the bottom point, which is momentarily at rest.—Sunshine. See Mr. Ranyard's most interesting article in our last number.—A. M. D. Thanks for the creatures taken from the soft roe of a bloater: I do not know them.—E. Franklyn. Anxious, like Mr. Sala, to avoid the workhouse; I am obliged to decline to "send answers, worked out," to puzzles: but the answer, worked out, appears in Knowledge for Nov. 23, p. 318.—F. L. Harris. The subject (watch-spring dissolved) was discussed in Knowledge a few months ago; being away from home, cannot refer to index. Of course the molecular condition of the watch-spring being affected by tension, the circumstances under which dissolution takes place (time and resulting condition of the acid) are different, and all the energy of tension may be thus accounted for; though equally of course the inquiry would be a very delicate one.—E. C. H. You must take into account both the westerly longitude of Worthing, which would make the time of sunset a little later by Greenwich time, and the difference of latitude which makes the day at Worthing in winter a little longer than at Greenwich, or hour of sunset later. Due account taken of these points, the hour given by the almanac for the sun's centre is about right; but as refraction is variable, you must not expect exactness.—J. Squire. Fleeming Jenkin's "Electricity and Magnetism" and Sprague's "Electricity" should answer your purpose.—Thomas Laws. Quite agree with you.—H. E. I suppose some folk noticed on several occasions that spring evenings when the moon was new had been wet, and concluded that the poor moon had something to do with the matter. At any rate it is when the moon is new in spring evenings (or when she is old in autumn mornings) that she is "on her back." If it chanced to be wet on such occasions a few times the weather saw makers would be bound to light on the discovery that

When the moon is on her back,
She holds the water in her lap.

—H. H. Thanks. Mr. W. M. Williams has already expounded his views about the Moon, Jupiter, &c., in "Fuel of the Sun." They *are* rather dismal astronomy, it's a fact.—Regular Reader. Úrsúla certainly; Mirándŭla and Staŭpitz, "au" as in *frau*, I should say; but such matters are outside our line.—J. E. F. The only grammar rule I remember relates to that subject, "Where Contingency and Futurity are both implied the verb should be in the subjunctive." It always seemed to me so wise to teach children (I was nine when I learnt this rule) about Contingency and Futurity and implying, and subjunctive. Where teachers were so idiotic, what progress were the taught likely to make?—Henry Clark. I am *quite* serious in saying that to speak of "man rising to the heavenly bodies" is not more exact than to speak of "the heavenly bodies rising to man." The former expression has the disadvantage of being absurd as well as inexact. *Did* you ever rise to the sun? You know very well you never did. If as you say, facts reqnire exactness of knowledge, then, instead of telling your children that "we rise to the sun," which is nonsense, you ought to speak of sunrise thus, or in words to this preposterous effect,—"Owing to the earth's rotation on her axis, the horizon plane—but pshaw! that's not exact—the curved surface formed by those lines of sight which appear to be directed towards the visible horizon line, but in reality, owing to atmospheric refraction, pursue a curved course till they pass beyond the limits of our atmosphere—this curved surface, I say, is so shifting its position in space, that, whereas it had passed above the sun, using the word 'above' with reference to my actual position at the moment, it is now passing athwart his disc, and will presently pass wholly below his globe—so that, whereas in its former position I could see no part of the sun, I now see a part of his disc, and presently the whole will be visible to me; by which I by no means wish to imply that he is actually where I seem to see him, or rather a part of him, but only that light-waves, which emanated from him rather more than eight minutes ago are falling on the retina of my eye, and received by the optic nerve are producing their particular impression which we call 'seeing,' and here I would correct an inexactness in what I have just said; I spoke of the rotation as the earth, I should have said the combined rotation and revolution, for inasmuch as the revolution of the earth round the sun affects the length of what we (very inexactly) call 'the solar day,' it must modify the rate at which the curved surface above mentioned moves amid space." That is a beginning, but a whole number of Knowledge would be required to express the matter properly. On the whole, I prefer for the present to say "The sun is rising." It is not only more convenient but more exact. For note that the direction of above and below are changing all the time, and that therefore in a sense perfectly defensible the sun rises. Your references, by the way, to Galileo, show that if you aim at superexactitude in astronomy, you pay less attention to exactness in matters of historical fact. Galileo did not discover that the earth rotates, nor even (though the imprisonment you refer to had more reference to that) that it revolves. If you must enthuse so warmly as you do in your letter, do try to enthuse over the right man.—F. W. G. There is no contradiction. Professor Smyth expressed the opinion that excess of aqueous vapour may account for the green sun in India, not for the recent red sunsets.—D. Mackay. Will try to find space.—J. A. Ollard. "Flowers of the Sky," written I think in 1873.

Our Chess Column.

By Mephisto.

THE BOOK OF THE TOURNAMENT.

Second Notice.

Our aim has always been to discourse on Chess play, and to treat all subjects closely allied to the game, from a scientific point of view. Accordingly, under ordinary circumstances, the rules and regulations of the Tournament—a matter of history—would not have been considered by us as a profitable subject for criticism. But in his introduction to the book the Editor does not content himself with merely giving us those rules and regulations, but he evidently desires, and recommends, the acceptance of his opinions upon each question by the Chess community, no doubt with the very laudable object in view of providing precedents for the guidance of conductors of future Tournaments. Under these circumstances we should be failing in our duty if we should leave unchallenged some of the laws and theories recommended by the Editor.

Thus the Committee were not content with giving us the rules of their Tournament, but have added the words, "published for the consideration of Chess-players, and especially of the managers of future International Chess Tournaments." These rules have been drawn up by Messrs. Donnesthorpe and Woodgate. They are not sufficiently comprehensive to rank either as rules for English Chess-players or as an International code. In the first instance, only a representative committee would be competent to draw up these rules—say, for example, Messrs. Donnesthorpe, Woodgate, and Minchin on the one side, and Messrs. Blackburne, Zukertort, and Steinitz on the other side, with Mr. Lewis as chairman. The rules contain a few stipulations that are unnecessary, while a great many necessary laws are not dealt with at all.

Section 8 says "A player may at any time call upon his adversary to mate him within fifty moves. If by the expiration of such fifty moves no piece or pawn has been captured, nor pawn moved

nor mate given, a draw can then be obtained." This may be best described as a vexatious law. We think the Editor was bound to omit this rule, as at an early stage of the Tournament the Committee abolished it, as it was found to be quite impracticable. A suggestion of a similar kind made by Dr. Lange before the commencement of the Nuremberg Tournament was by all players present declared to be unworthy of discussion.

Rule 8 of the programme provides that only the third draw should count as half to each player. In reference to this rule the Editor states that "a section of the English Chess players, supported by their partisans in the Chess press," were opposed to this rule. We do not think the Editor was justified in publicly ascribing the criticism of the Chess press to partisanship. If the latter does exist Mr. Minckin, in his position as hon. secretary of the most important Chess organisation of the country, will, we hope, find plenty of opportunities to discountenance such practices. We still think the objection to this rule well founded, although we always admitted that something was required to be done to check mere playing to the score by draws.

We are told that the opinions expressed (by letter) of probable English and foreign competitors of the tournament were largely in favour of the draws not counting. While not wishing to deny this as a fact, we beg to remind the Editor of the following equally important fact—that a day or two before the tournament most of the foreign competitors were holding meetings and loudly clamouring for the abolition of Rule 8, and that a majority of the competitors were decidedly opposed to it. In reference to this rule, the Editor tells us: "I considered it our duty to devise rules that should most effectually crush the weak, and discover by selection the strongest." We hope, for the sake of Chess and rising Chess-players, that future committees will never again adopt this perverted application of an equitable doctrine well known in legal and sporting practices—namely, that leniency should be inclined on the side of the weak. We fail to see why a weak player should be prevented from playing to draw (however undesirable that may be) if by the same rule *a strong player is enabled to play for a draw in a doubtful position against* a weaker player, relying upon three games to scoring one. In fact, we think the question may be reduced to a problem in simple arithmetic. English scored 15½; Mackenzie, 15½; and Mason, 15½. English played 45 games; Mackenzie, 41 games; and Mason, 39. We decidedly assert that Mackenzie's performance is a better one than that of English, and that Mason has proved himself stronger than either of the two, and that, therefore, both these players have been wronged by Rule 8, but for which English must have ranked below them. But the Editor himself admits the impracticability of Rule 8 by recommending its modification to "Where two opponents have drawn, *and are satisfied with that result*, the draw should be allowed to be final."

The Index is capable of much improvement. It cannot be ascertained from it where the score-sheets, rules, laws, &c., are to be found. Each player ought to have had his games given complete under his name, regardless of the double references, and that in alphabetical order. An index of the games arranged according to the openings would likewise have been welcome.

Our next notice will be devoted to the more congenial task of examining the analytical contents of the book.

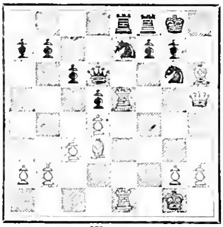
ONE OF A NUMBER OF GAMES PLAYED BY MR. BLACKBURNE AT THE WHITEHAVEN CHESS CLUB.

French Defence.

White. J. H. Blackburne.	Black. J. B. Mason.
1. P to K4	P to K3
2. P to Q4	P to Q4
3. Kt to QB3	Kt to QB3
4. Kt to KB3	B to QKt5 (*a*)
5. B to Q3	Kt to K2 (*b*)
6. Castles	Castles
7. KP takes P	P takes P
8. Kt to K2	Kt to Kt3
9. Kt to Kt3	B to KKt5
10. P to QB3	B to Q3
11. P to KR3	B takes Kt
12. Q takes B	QKt to K2
13. Q to KR5	P to QB3
14. B to Q2	Q to B2
15. QR to K sq	B takes Kt
16. P takes B	Q takes P
17. R to K3 (*c*)	Q to Q3 (*d*)
18. KR to K sq	QR to K sq
19. R to K5	P to KR3
20. B takes P (*e*)	Kt to B5 (*f*)
21. B takes Kt	P to Kt3
22. Q to R6	Resigns

Position after White's 20th move.

Black.



White.

NOTES.

(*a*) Not good; B to K2 is the proper move.

(*b*) K2 is an inconvenient square for the KKt in this opening.

(*c*) White is fully compensated for the Pawn by getting his Rooks into full play; the combination which follows is highly interesting.

(*d*) B2 would have been a far better square for the Q.

(*e*) Delightful play. Black's best course would have been to have taken the B, when the game might have continued as follows:—P takes B. 21. Q takes P, Q to B3 (to provide against R to R5). 22. P to KR4, Q to Kt2 (if Q takes P. 23. R to R5, Q takes R (ch). 24. K to R2, and wins). 23. Q takes Q (ch), K takes Q. 24. B takes Kt, P takes B. 25. R takes Kt (ch), with the better game. See diagram in the previous column.

(*f*) This is useless. To take the Rook was not so good as it looked. The game might have proceeded as follows:—Kt takes R. 21. B takes P (if now K takes B, White will win the Q in two moves, by Q to R7 (ch), &c., but will have given two Rooks for it). If Kt (K4) to Kt3, then follows 22. B to K5, Q to Q2. 23. R to K3, P to B3 (if P to B4, then 24. R to R3). 24. R to Kt3, R to B2. 25. B takes Kt, Kt takes B. 26. R takes Kt (ch), R to Kt2. 27. B takes P, R takes R. 28. Q takes R (ch), K to B sq. 29. Q to R6 (ch), K to B2. 30. Q to Kt7 (ch), K to K3. 31. Q to Kt4 (ch), K to Q3. 32. B to K5 (ch), K to K2. 33. Q to Kt5 (ch), K to B sq. 34. Q to R6 (ch), K to B2. 35. Q to Kt7 (ch), K to K3. 36. Q to B6, mate. If, on the other hand, Black at any time exchanges R for B, then, of course, White wins by superiority of Pawns.

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Contents of No. 112.

THE UNIVERSE OF SUNS.

By Richard A. Proctor.

ALTHOUGH we are placed at present in a far more advantageous position for forming an opinion respecting the constitution of the heavens, than any of those who have in former ages inquired into this subject, yet we cannot afford to neglect any of the hints thrown out by men like Galileo and Huyghens, Wright, Kant, Lambert, and Michell. Moreover the account of former hypotheses respecting the universe is full of interest.

The ideas of ancient astronomers respecting the stars were naturally very far from the truth. Anaximenes regarded the stars as studs on the crystalline sphere, while Theophrastus supposed that the celestial sphere consists of two distinct halves fastened together along the Milky Way, but so imperfectly that we can see through the unclosed spaces the luminous heavens beyond. Xenophanes taught that the stars are clouds collected in the upper regions of the air, and fed from the fiery æther. Hence the remark of Callimachus that the circumpolar stars feed on air; and hence the question of Lucretius, "*Unde æther sidera pascit?*" Anaxagoras considered that the stars, as well as the sun, moon, and planets, were rocks swept off from the earth by the æther, and kindled to an intense heat in the fiery upper regions.

Passing, however, from these vague fancies, let us turn to those hypotheses which were formed when the Copernican theory enabled men to form some conception of the enormous distances of the fixed stars, and when telescopic researches began to reveal vast numbers of stars hitherto unseen by man.

Copernicus himself occupied a somewhat exceptional position, since he was the only astronomer who ever theorised respecting the stars on the basis of the system which bears his name, but without the knowledge respecting unseen stars which his successors obtained by means of the telescope. It should be noticed also in considering the views of Copernicus, that though he had abandoned the Ptolemaic astronomy, he had by no means abandoned the artificial conceptions on which Ptolemaic astronomy had been based. That this is so, can be recognised even in the account which Copernicus gave of the motions within the solar system; it is still more apparent in his remarks respecting the universe. "It is to be observed in the first place," he says, in his treatise "De Revolutionibus," "that the universe is spherical; not only because that is the most perfect of all figures, needing no fastening or junction, complete in itself; but because it is the most capacious figure, fittest to enclose and preserve all things; because the most perfect portions of the universe,—the sun, moon, and stars,—are seen to have that shape; and lastly because, as we see in drops of water and other liquids, all things capable of assuming the figure they prefer, select the figure of a sphere." Of the sphere of stars, however, he remarks only, that it is the outermost and chief of all the spheres, immovable because enclosing all other spheres.

Galileo, the first Copernican to recognise the enormous extent of the stellar regions to which the unaided eye cannot penetrate, formed no theory respecting the universe. He saw clearly, however, the extreme importance of those revelations made by the telescope, and their bearing on the theories men had formed respecting the Galaxy. "It is truly a wonderful fact," he said, "that to the vast number of fixed stars which the eye perceives, an innumerable multitude, before unseen, and exceeding more than tenfold those hitherto known, have been rendered discernible. Nor can it be regarded as a matter of small moment that all disputes respecting the nature of the Milky Way have been brought to a close, and the nature of this zone made manifest not to the intellect only, but to the senses."

Kepler was the first astronomer who enunciated definite ideas respecting the constitution of the universe. In 1618, or nine years after the publication of the two first of the laws which bear his name, he published the first three books of his "Epitome," the fourth in 1620,* a year after his third law had been published in his *Harmonia Mundi*. The following statements have been extracted from the "Epitome" by W. Struve, and form a fair abstract of the ideas of Kepler:—

The sun lies farther from the fixed stars than these lie from each other. Within the sphere of the fixed stars there is a vast concavity girt round on all sides by the stars. The sun lies within this space, so that the solar system occupies an exceptional position in the universe. The concavity enclosing the sun lies also near the centre of the zone called the Milky Way. This is shown by the fact that the Milky Way appears as a great circle on the heavens, and sensibly of uniform brightness throughout. The space occupied by the stars, limited on the inside by the concavity enclosing the sun, is also limited on the outside, and thus forms an immense spherical shell, outside of which lies *space*.† The sun is the chief body—the *heart* of the universe,—whence flow light and heat; he is also the ruler of the planets and their satellites. The sphere of the fixed stars is as the *skin* of the universe preventing the escape of the solar heat and reflecting the solar light. It is therefore as of ice, by comparison with the fiery mass of the sun. The stars according to this hypothesis are much smaller than the sun, but shine with their own light, the light of each having its own proper colour.‡

* Not 1622, though the title-page bears that date.

† Kepler bases this conclusion on the same reasons which Copernicus had already alleged.

‡ He admits, however, that the sun may possibly be only a star, brighter because nearer than the rest; and that the other stars may be surrounded, like our sun, with planetary schemes. "This, however," he remarks, "is not a necessary inference from the Copernican system, which decides nothing respecting the nature of the fixed stars. We are therefore free to admit that the fixed stars are spread, as the Hebrew tradition asserts, within a stratum comparatively thin and of a watery nature, and that this stratum is crystalline, the water in it being frozen on account of its great distance from the sun, the centre of the heat of the universe."

But the most remarkable part of Kepler's speculations is that in which he determines the dimensions of the sphere of the fixed stars. It affords a striking illustration of his strange faith in numerical analogies; a faith however accompanied by that perfect desire to ascertain the truth which had already caused him to abandon one after another a series of many such relations, suggested by his poetic imagination while he was dealing with the solar system.

The radius of the concavity enclosing the sun was determined by a simple proportion. Saturn the outermost planet travels at a distance from the sun equal to 2,000 times the sun's radius. Therefore by the harmony of relations, the distance of the sphere of the fixed stars is equal to 2,000 times the distance of Saturn from the sun. *This enormous distance is confirmed by the observations of Tycho Brahé which show no annual displacement of the stars as the earth sweeps round her widely-extended orbit.* But the thickness of the crystalline shell can also be determined. All the matter of which the universe is formed is divided into three equal parts. One third is included in the body of the Sun. Another third forms the substance of the planets and of the celestial æther which fills up the space within the sphere of the fixed stars. The remaining third forms the Crystalline. Now since the æther fills a space exceeding the sun's volume 64 trillions of times [$(4{,}000{,}000)^3$], its density must be proportionately small compared with his. And the density of the crystalline must needs be a mean between the sun's density and the æther's. Thus the crystalline has a density 8,000 million times less than the sun's; and as its mass is equal to the sun's its volume is 8,000 million times greater. Hence it is easy to calculate its thickness, which is found to be equal to the 6,000th part of the sun's radius.* So that according to the modern determination of the sun's dimensions, Kepler's theory assigns to the crystalline a thickness of but about seventy miles!

Struve remarks very justly that these ideas of Kepler's, fanciful though they are, yet merit attention, because they contain the germ of modern views respecting the universe. This remark relates specially, it would seem, to the passage which is italicised, and to the admission presented as a note. Struve adds that it would even seem as though Kepler had sought only to accommodate the Copernican theory with the ideas entertained in his day respecting "the waters above the firmament," spoken of in the Pentateuch. (*To be continued.*)

Blackwood's diaries for 1884 are again before the public, some of them having been started twenty years ago. [I have used the "Six Days' Diary" for twenty years.—R. P.] They now number over thirty varieties, so as to meet the wants of every person keeping a diary, as every one should. Most of these diaries contain three maps, an almanack with events and dates, and calendars for 1884-5. All information is officially corrected; the prices range from 1d. to 12s. The sale is very large, in one case 50,000 yearly.

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* Struve says 60,000, probably from his own calculation, as he proceeds to employ the modern estimate of the sun's distance. But the number should be 6,000. The calculation proceeds thus,—The volume of the sun is equal to one-third of a cylinder having a base equal to the sun's surface and a height equal to his radius; and the volume of the crystalline is equal to a cylinder having the surface of the crystalline for base and the thickness of the crystalline for height. The surface of the crystalline exceeds the sun's (according to Kepler) 16 billions of times—so that the volume of the last named cylinder would be 48 billions of times larger than the sun's if its height were equal to his radius. But its volume is in reality but 8,000 million times larger than the sun's. Hence its height must be the 6,000th part of the sun's radius—48 billions containing 8,000 millions 6,000 times.

LADYBIRDS.

By E. A. Butler, B.A., B.Sc.

Ladybirds are beetles; or, in other words, their organisation and developmental history are of the same type as those of the Stag Beetle, Dung Beetle, Colorado Beetle, and a host of other similar creatures. They have no connection with the fleet-footed and foul-smelling household pests commonly though erroneously called "Blackbeetles," and more correctly named "Cockroaches." These are not beetles at all, but in consequence of great differences both in structure and style of development, are to be referred to quite a different order, that, namely, which includes grasshoppers, crickets, &c. To satisfy oneself as to the zoological position of ladybirds, a specimen should be dissected, or at any rate so arranged as to display all its external organs. Suppose now a good-sized ladybird is before us, say one with seven large black spots on its red arched back. We place the creature with its flat side downwards and then observe that the upper part is readily divisible into three areas, slightly movable upon one another. The first, which is the smallest, is the head; besides the organs of the mouth, which will be referred to further on, it carries two tiny, many-jointed clubbed appendages, which are the antennæ, and two great masses of eyes, one on each side. No such thing as a neck is visible, and the head seems sunk in the second part of the body, the edge of which forms almost a continuous curve with that of the head. This second part, the prothorax, is considerably wider than the head, and much arched, like a long narrow shield thrown across the body and excavated a little in front to receive the head. Behind this comes the greater part of the insect, but here we get to greater complexity; we find that the arched back is not solid; we note a central longitudinal line of division, and on dexterously inserting a needle here discover that we can raise and move somewhat aside each of the halves at their outer extremity, but that at their other end they are hinged to the body. They are now seen to be two horny curved shields, stout and stiff, and capable of covering completely two more delicate membranous wings which are folded up underneath them, one on each side. These, on being unfolded, are found to be rather more than twice as long as the space in which they lie, or as the shields which protected them; they are brownish in colour, and flexible, and are folded transversely in the middle, and the outer half is turned back underneath the basal part. They are the true organs of flight, and when the ladybird takes to the wing, as it might be tempted to do in bright sunshine, the upper shields are merely raised to give free play to the wings, and are not themselves vibrated. Underneath the wings we come to the real body, which, when the insect is not flying, is completely concealed above under the great arching shields.

Turning the creature over on its back, we see that the underside is nearly flat, and is altogether differently coloured from the upper part; the six short legs are capable of being folded up, joint upon joint, and packed away so neatly in slight hollows excavated for their reception that when thus closed they scarcely interrupt the general level of the surface, and are rendered quite invisible from above.

The organs of the mouth are so small that they require considerable care in their examination. A fine needle will be found useful in opening them out, and a hand lens in making out their form and arrangement. Beginning from above we find, under a broad, overhanging kind of lip, a pair of stout, broad, horny jaws, or mandibles, each

ending in two sharp points; they move sideways and close upon one another like a pair of shears. Next come a pair of more delicate jaw-like organs, the maxillæ, each of which carries a large, jointed appendage, the maxillary palpiss, the last joint, the largest, shaped something like an axe-head; these hatchet-like pieces are by far the most conspicuous objects in the head. Between the maxillæ is a thin plate, the labium carrying another and smaller pair of jointed organs, the labial palpi. Now the presence of the pair of horny sheaths covering the transversely-folded membranous wings, and the structure of the organs of the mouth, which are adapted for biting, and not for sucking or licking juices, are characteristics of the order of beetles; and so, if a stag-beetle, dung-beetle, Colorado beetle, or other member of the order be examined, the wings and mouth will, as a rule, be found to be constructed on the same plan.

Like other beetles, too, ladybirds pass through a series of remarkable transformations during their brief life. The parent insect lays her yellow eggs on some plant infested with aphides, or blight, as they are popularly called. From the eggs emerge little six-footed creatures of a slaty colour, sprinkled with yellowish dots, and further ornamented with a number of warts or tubercles. They attack and make short work of the aphides, and grow fat upon the diet. But after a while, a great change occurs; the grub becomes transformed into a pear-shaped body, wholly devoid of limbs, and attached by the smaller end to a leaf or some other support. In this condition it remains for a time perfectly quiescent; then the skin bursts, and there creeps forth a limping, soft creature, in form a ladybird, but in consistency something like a boiled pea. Exposure to the air after a time hardens its skin and at the same time deepens its colour, and then we have the adult ladybird fully equipped for setting about the great task of the perpetuation of its kind. When on the wing it flies vigorously, but it is a poor pedestrian, walking at no great rate and with no very certain steps, and ready at slight provocation to tuck its legs in close to its body and feign death, in which condition it may be tossed about without manifesting any signs of vitality. This is not its only means of protection, for it is able to exude a yellow oily fluid of powerful and rather offensive odour, and no doubt of equally unpleasant taste. This must make it an extremely nauseous morsel to any foe that has the temerity to attempt to make a meal of it. Not only during its grub-like babyhood is it the ruthless destroyer of aphides, when it has assumed the responsibilities of adult life the old taste still persists, and the war of extermination is prosecuted with vigour, those bifid mandibles forming excellent weapons for tearing to pieces the bodies of the sluggish but luscious plant-lice. It must therefore be reckoned as one of our insect friends, and its frequent presence in large numbers in hop gardens will be regarded with satisfaction, when we remember how peculiarly liable the hop-plant is to the attacks of aphides.

Our British fauna can boast of about a score of species of ladybirds. Some of these are very abundant, others scarce; some are very constant in their coloration, others vary so much that it is difficult to find two specimens exactly alike. In some species the spots are black on a red or yellow ground, in others cream-coloured or yellow on a black or dark red ground. The spots may be either round or angular; they are generally simple, but in one or two instances are surrounded by a ring of another colour. Finally, one species has no spots at all, but a distinct black M-like mark on the thorax. The spots vary in number in the different species, but are, as a rule, remarkably constant in different specimens of the same species. Thus there are species with 2, 5, 7, 11, 12, 13, 14, 16, 18, 19, and 22 spots respectively, that is, reckoning only those that adorn the wing cases. The commonest of all is that which has two spots, one on each wing-case; its usual coloration is black spots on a red ground, but sometimes the black spreads so as to almost entirely cover the back, leaving only two shoulder-spots of red, and the insect then looks so different that it is difficult to believe that it is the same species. Some species, the most handsome of the group, are specially addicted to fir-trees; others occur in damp places, and some few, such as the two and seven-spotted forms, may turn up anywhere.

CAVERNS IN EARTH AND MOON.

By Richard A. Proctor.

As I find few points in my views about the future of the Earth-World received with more difficulty than my statement that the waters of the sea, if they should eventually retreat into the earth's interior, as Sir Isaac Newton suggested, could certainly never retreat into cavities—seeing that "such cavities could no more exist in the solid frame of the earth than within the mass of an ocean," I take pleasure in quoting some remarks by Mr. W. Mattieu Williams, bearing very pertinently on this matter,—as well as some remarks relating to limestone caverns, showing one of the ways in which waters once above the earth find their way below its surface. It will be inferred from Mr. Williams's words that some persons, presumably Oxonians or Cantabs, have recently been advocating the preposterous theory of which he so effectually disposes. And although it may seem to many that the theory requires no answer, being inherently too absurd for belief, I know from experience that the case is otherwise. Many who have spoken to me after my lecture on the "Life of Worlds" have shown that they still retain a vague hankering for this impossible view, which associates itself conveniently with Sir David Brewster's explanation of the small density of the external planets.

I may add that the capacity of some persons for starting off with a full and complete idea—as they suppose—of a special theory, from perhaps a casual and blundering remark about it in some newspaper paragraph, would be regarded by many as absolutely incredible.

It will be observed that Mr. Williams in touching on the theories which he himself advanced in his ingenious, though rather crude, "Fuel of the Sun" speaks of them with great confidence,—a tone not usually sustained as advancing study teaches the limited nature of our knowledge, and the utter impossibility of forming any widely extending theory (especially a theory of the universe). That however need not prevent the reader from accepting the grains of real information conveyed in what follows. The "perpetual motion" theory, which underlies what Mr. Williams suggests as to the unvarying condition of the several orders of bodies in the universe, seems, oddly enough, acceptable, on a very large scale, to those who would laugh at it if advanced in regard to mechanism on some more appreciable scale,—who might even invite the inventor of the mechanism, as Robert Stephenson did in such a case, to carry himself round the room by the waistband of his own trousers and *then* explain his perpetual motion. Mr. Williams's wider perpetual motion (really but a much magnified mistake) might lead rude persons to suggest a more heroic achievement,—he might be asked to convey himself by the aforementioned waistband on a lecture tour round the world and *then* try to establish the perpetual mechanism of suns and sun systems, and (as an additional trifle) the amazingly im-

possible mode of generation of solar systems which he has advanced in his "Fuel of the Sun." But these wild fancies of a mind really most practical in terrestrial matters, are not our present (or likely to be our future) game. What follows, apart from references to such matters, is well worth studying, and especially useful reading for those Cantabs or Oxonians who seem to have advocated the doctrine of monstrous internal lunar or terrestrial cavities:—

"'The Curiosities of Science' would form a subject for quite as thick a book as Disraeli's 'Curiosities of Literature.' Whoever may write it should devote a full chapter to the hypotheses of the moon's senility, Jupiter's juvenility, the earth's middle age, the cooling down of the sun and stars, and the general dying out of the universe." [Another might be devoted to theories of perpetual motion, on whatever scale imagined.]

"A full discussion of this subject would far outrun the limits of a note, but I may remark, in passing, that I have stated in 'The Fuel of the Sun' my reasons for concluding that our sun and solar system, and all the other suns, systems, and nebulæ within the reach of human observations, have during all time within the limits of human conception been on the average just as hot and as bright as at present, though subject to a fluctuation both up and down; and that Jupiter, Saturn, Uranus, and Neptune were always minor suns, and must always continue to be such." [Perpetual motion on a large scale is very properly put, "in passing," as a striking illustration of the idea broached in the preceding paragraph].

"A branch of the dismal hypothesis now in fashion is the supposition that the moon was formerly a verdant world with land and sea, rivers and lakes, atmosphere and clouds; and that by internal shrinking, which its crust has not followed, there are caverns as big as its former oceans, and so deep that all their waters and all the ancient lunar atmosphere are swallowed into them; that our earth will ultimately grow old, will die, and become as cavernous inside, and as arid and airless outside, as the moon is now.

"That such a dream should occupy the waking hours of men living on this planet, and knowing something of the properties of the materials of its surface, is curious indeed. Had they been educated in a colliery instead of Cambridge or Oxford, they could not possibly have been deluded by any such monstrous physical fable.

"They would have known that when a cavity of notable horizontal area is formed anywhere in the crust of this earth, whether 20 yards, 50 yards, 100, 200, or 500, or 1,000 yards or more below the surface, the mere weight of the superincumbent rock squeezes itself down until the roof of the cavity touches the floor; and that the permanency of any such a cavity (or its existence even for a year or two) is a physical impossibility.

"So inevitable is this that in the old mode of coal working by 'pillar and stall' a deplorable waste of coal occurred. 'The pillars of coal that are left to support the roof form frequently as much as three-fourths, and never less than one-third, of the whole seam' (Tomlinson). A portion of these are finally removed, but in order to protect the miners artificial wooden pillars or 'juds' are supplied to support the roof. When these are removed, the roof falls in by the bending down of the hundreds of yards of rock above, and shivering of the immediate surface of the roof.

"If those who believe the moon to be the abode of caverned oceans and atmosphere, and who imagine that our earth will follow its example, would make a pedestrian trip through the Black Country between Birmingham and Wolverhampton, under which the great ten-yard coal seam formerly existed, the spectacle of leaning chimney shafts, split cottages, and toppling houses would show them what would happen *if* the interior shrinkage of the earth produced but very remote approaches to their imaginary caverns.

"The most remarkable of these effects is that of the yielding—I say 'flowing'—of the rock not immediately over the removed coal. The area of the superficial sinkage basin is considerably larger than that of the hollow filled up, but, of course, proportionately less deep. From this it follows that houses not actually undermined are sometimes wrecked or damaged. 'Sunnyside,' near Caergwrle, Flintshire, a house occupied by a friend of mine, was split down through the middle while his family were in occupation. It was well built and of good size. Had it been a London suburban villa of the ordinary Jericho order of architecture the consequences would have been serious. As it was, he deliberately moved to another house, and Sunnyside was left until the subsidence was completed, when the chasms in the wall were filled up by the proprietors of the colliery, whose workings had only approached but had not reached it. This is merely one example, hundreds might be quoted.

"In modern 'long wall' working the coal is removed by working away from a long face of coal at the boundary farthest from the pit, then approaching the pit in a long line, supporting the part where the men are immediately at work. As soon as the distance from the original wall exceeds a certain extent the roof collapses, and thus the collapse follows the workers.

"If such puny excavations cannot exist, how monstrous is the assumption that caverns capable of swallowing the Atlantic Ocean could remain for even half an hour!

"Natural caverns rarely attain the span of Brunelleschi's dome, or that of the Albert Hall, and never reach that of the Midland Railway station at St. Pancras, unless supported by stalactites and stalagmites. A multitude of proofs of the limits of their possible area is afforded by their collapse, cases of which (like Daddy Hole Plain, Torquay) may be traced in almost every great limestone district. At earth depths corresponding to maximum ocean depths, not only great caverns but even minute filtration pores are impossible, as proved by the experiments of Spring, described in my notes on 'Regelation and Welding' (August, 1882), and on 'Transfusion by Pressure' (February, 1883).

"As the origin of natural caverns is not generally understood, I may supplement the above note with a short explanation.

"Generally speaking, they occur in limestone rocks. There are a few exceptions, such as that on the Island of Thermia (Greece) in argillaceous schist, and those on Etna formed by the hardening of lava during the escape of pent-up vapour, but such exceptions are very rare; while, on the other hand, there are very few ranges of compact limestone where caverns are not more or less abundant.

"Take a little clear lime-water in a wine-glass, and blow through it by means of a glass tube, a quill, or tobacco-pipe. It becomes turbid by the conversion of the soluble caustic lime into insoluble carbonate. Most of the limestone rocks have been formed by chemical action nearly resembling this precipitation.

"Now continue the blowing, and the further supply of carbonic acid will ultimately dissolve the carbonate of lime it first precipitated. This is the action that excavates the limestone caverns.

"Rain-water picks up a little carbonic acid on its way through the air, then more and more as it flows over vegetable matter. Thus charged it dissolves, slowly it is true, but surely, the most compact limestone. I have walked

through a few miles of natural tunnelling in the marble mountains of Carrara.

"In limestone districts small rivers are in the habit of suddenly disappearing, and breaking out in fresh places a few miles distant. A legion of legends are based upon these, that of Alpheus and Arethusa being the most popular and typical. When I visited the fountain of Arethusa it was the public laundry of Syracuse, and not one nymph, but above a score of nymphs were there. It is a considerable stream, that breaks out through a limestone tunnel directly on the sands of the sea-shore.

"There are about half-a-dozen of such subterranean streams in the Craven district of Yorkshire, and more than a dozen in Ireland.

"The solvent power of the water reaches its maximum when it has oozed through a peat bog. The river connecting Lough Mask with Lough Conn is a striking example of this. Its subterranean evolutions are most complex, and the hard limestone is riddled with caverns of all sizes, from little holes affording winter quarters for solitary toads to the show caverns that are duly exhibited to tourists for a consideration.

"An absurd result followed from this condition of the rock. A canal for extending the inland navigation from Lough Corrib to Lough Mask, thence to Lough Conn and the Moy River to Killala Bay was projected, thus connecting Galway Bay with the Bay of Donegal. The canal was actually cut in the hard rock between the lakes, and finished all ready for filling. When the water was admitted it disappeared, and the cutting now remains as a costly tributary to a subterranean river."

EVIDENCES OF THE GLACIAL PERIOD.

It is hoped that this paper may be useful alike to those who have no acquaintance with geology and to those who have some knowledge of that science. To the former, its chief object will be to enumerate in a brief summary—"plainly worded, exactly described"—the evidences which have led geologists to the belief in a Glacial Period; while to the latter it may not be altogether useless as a convenient summary of such evidences. The writer, therefore, begs the indulgence of his readers if in some cases he has been somewhat elementary and given to repetition, for which his only apology must be the desire to make the truths of science plain and clear to all.

When we see the ruins of a house with charred timbers and blackened walls, we conclude at once that that house has been burnt by fire. It does not matter if we have not seen the fire ourselves, or if no one has told us about it; we still feel certain that fire has been at work, simply because we know from experience that it is in the nature of fire to char timbers and blacken walls, and because we know of no other cause capable of producing those results.

It is by a precisely similar train of reasoning to the above that we feel certain that glaciers or rivers of ice once ploughed their way down our English valleys, and that a covering of solid ice once enveloped the whole of England. We believe this because throughout England are marks upon the scenery of the country which glaciers and ice are elsewhere producing to-day, and which we know of no other cause capable of producing in England during the past, except that of the same agents of glaciers and ice; therefore, we conclude that these agents did formerly exist in England, and we give to the time when such was the case the name of the Glacial Period.

In order that our readers may be able to verify this conclusion for themselves we shall now describe a few of those marks in the scenery to which we have referred as being produced by glaciers.

(1.) *Moraines.*—In Switzerland, where glaciers exist at the present day, wherever those glaciers occupy the valleys, moraines are found. These moraines are composed of fragments of rock, large and small, which, having become detached from the adjoining hill-sides, roll down on the glacier, and are carried along by it, forming long continuous lines of blocks and fragments along its sides. When this accumulation is found along the sides of glaciers it is termed a *lateral* moraine; when, owing to the junction of two glaciers from separate valleys, two of these side or lateral moraines unite to form a central line of blocks and fragments, the latter is called a *medial* moraine; and when a glacier comes to an end through having descended into regions too warm for its existence, and where it is melted away, a vast heap of rubbish brought down by the glacier is thrown down at its termination, which is called a *terminal* moraine. Now, exactly similar lines and heaps of blocks and fragments are found in our English valleys, and as we know of no cause capable of producing them except glaciers, it is only reasonable to suppose that those found in England are due to the same causes as in Switzerland, and therefore we come to the conclusion that, although glaciers do not now exist in England, they did formerly, and then produced those moraine lines and heaps which we now find in our valleys.

(2.) *Polished and Striated Rock Surfaces.*—When a glacier passes over a rocky surface, it polishes and makes the same quite smooth and bright. Sometimes it makes scratched markings upon such surface. This is done by pieces of hard and sharp rock which have got frozen into the glacier, and such markings are generally pretty near parallel and in the same direction, consequently showing the direction in which the glacier is moving. Now very many of these polished and scratched rock surfaces are founded in England, and as they present an identical appearance with those found in Switzerland, it is but reasonable to set down both to the same cause—namely, glaciers.

(3.) *Erratic Blocks.*—At many places in Yorkshire may be seen large boulders of granite, mountain limestone, &c., several tons in weight, some being of exactly the same material as that composing the mountains of Cumberland. In fact several boulders of granite to be seen lying on the cliffs of Yorkshire have evidently been derived from Shap Fell in Cumberland. Now the question arises, how have these very heavy boulders been brought down from Cumberland to Yorkshire? For a long time this question was a perfect puzzle, until it was observed in Switzerland that large boulders had been carried down from the Alps by glaciers and spread over the plains below, in some cases extending as far as the foot of the Jura mountains. Here, then, was the clue to the mystery. A power had been discovered capable of removing immense and heavy blocks of rock for long distances—that power was the glacier; and as no other power but moving ice was known capable of removing these heavy blocks, it became evident that it could only have been ice which had removed these huge blocks of Shap Fell granite to their present place on the Yorkshire plains and cliffs. From these "erratic blocks," as they are called, being dispersed all over England, and not always in a line with the present valleys, it is concluded that during the severer portions of the Glacial Period, England not only had her valleys filled with glaciers, but that the whole country was "moulded" in ice, from the higher portions of which, such as these Cumberland mountains, erratic blocks were dispersed in all directions.

(4.) *Perched Boulders.*—When a glacier, owing to gradual softening of climate, melts away, it leaves the huge masses of rock it has borne down very often "perched" in very peculiar positions, so peculiar that we know of nothing capable of placing huge blocks of stone in such positions, except receding glaciers. Very many of these "perched boulders" may be seen in Britain, especially among the mountains of Scotland and Wales, evidently left in their present position by glaciers which have now disappeared.

(5.) *Scored and Rounded Mountains.*—These same mountains of Scotland and Wales by their scored, rounded, or worn flanks, present an identical appearance with mountains elsewhere where the very same appearance is produced by ice. Consequently the tale they tell of the former action of ice is obvious.

(6.) *Dome-shaped rocks.*—When huge masses of rock lie in the bed of a glacier, they become so worn and rubbed by the glacier that they assume a dome-shaped form, bearing a fanciful resemblance to the backs of a flock of sheep, and hence called in French "*roches moutonnées.*" These dome-shaped rocks are found plentifully in all countries where glaciers exist to form them, and as they are found plentifully in Yorkshire and elsewhere in England, the conclusion is irresistible that glaciers once existed to cause them in our own land.

I think it will be clear from the foregoing marks in the scenery of the country which I have enumerated and described, that the evidence for the existence of a Glacial Period in the Northern Hemisphere generally (for these marks are not confined to England, but are found over the whole of the north of Europe, and in the United States and elsewhere in America) is of exactly the same kind as the evidence afforded by a house that has been burnt. For just as charred timbers and blackened walls tell us plainly that *fire* has been at work, so moraines, polished rock surfaces, erratic blocks, perched boulders, scored and rounded mountains, and dome-shaped rocks tell us plainly that *ice* has been at work. Although we may neither have seen the fire that burnt the house, nor the glacial ice that left these marks, although there may have been no eye-witnesses in either case, still this does not affect our conclusion; for just as we know that fire, and fire only, produces the appearances we see in a burnt house, so we know that ice, and ice only, produces those marks in the scenery which have been enumerated. Therefore, we conclude that, wherever those marks are found, ice, and ice only, has caused them.

Striking as these evidences are of the existence in England and the northern hemisphere generally of a Glacial Period, they are by no means the only evidences. Besides these six several features in the scenery which may be grouped together under the head of Inorganic Evidences, we have in addition thereto Organic and Collateral Evidences. We will look at each of these somewhat in detail in our next article ROBERT B. COOK.

CHEAP AND GOOD FOOD.*

By T. R. ALLINSON, L.R.C.P.

ALLOW me to bring under the notice of your readers some experiments I have just concluded to solve the difficulty of feeding our poor in London and elsewhere. The cry is that food is so dear the poor can scarcely live. This cry is true if they want to live on luxuries, but if they will live on wholesome but plain and healthy fare they can do so for very little. A little over a month ago I determined to give up all expensive articles of food and live almost as cheaply as possible. Having left off flesh foods for nearly two years, and lecturing frequently on the question of food, I knew what to select. Looking over my food accounts, I found milk, butter, eggs, and cheese, with tea and coffee were fairly expensive articles, and none of them necessary, so I gave them up for a time to see results. On October 19 I began my experiment; my weight was then 9 stone 8 ounces. I continued this purely vegetarian diet for a month, when my weight was 9 stone 3 pounds 12 ounces, or a gain of $3\frac{1}{4}$ pounds. My friends said I looked well; I felt well, and did my usual work the same as ever. I walked from 10 to 15 miles daily, seeing patients or taking exercise. Here is an account of my dietary, which cost me little more than sixpence a day, and I could easily live for less without luxuries:—Breakfast consisted of a basin of porridge, made from a mixture of oatmeal and wheatmeal, which I found more palatable than either singly. This I usually eat with bread to insure thorough insalivation. Then came bread fried in refined cotton-seed oil, or fried vegetable haggis. For drink I had a cup of cocoa or fruit syrup, with warm water and sugar. The cocoa used was an ordinary one with plenty of starch in it, which makes a thick drink, and no milk is then required. Dinner consisted of a thick vegetable soup and bread, potato pie, savoury pie, vegetarian pie, vegetable stew, stewed rice and tomatoes, &c. For a second course I had bread plum-pudding, stewed rice and fruit, baked sago, tapioca and apples, stewed prunes, figs, raisins, and bread. Tea meal consisted of bread and jam, stewed fruit, or some green stuff, as watercress, celery, tomatoes, &c. I had only three meals a day, and frequently, when very busy, I had only two, and a cup of cocoa and a biscuit for supper. I always use the whole-meal bread, as it is laxative and contains a good deal of nitrogen, which is thrown away with the bran. The cotton-seed oil is a cheap and good cooking oil, and is impossible to detect. This diet I continued for a month, and now I only take the animal products when out, not having them at my table.

Now compare this diet with one of flesh or a mixed one. The latest analysis shows flesh to contain from 70 to 74 per cent. of water, the dry residue being very rich in nitrogen, and it contains a little carbonaceous or fatty matter. Hence, to live on meat alone, as much as 8 lb. a day is necessary. Then there are to be considered the diseases of animals which are communicable to man if that flesh be not thoroughly cooked all through, and as very few of our animals live a perfectly natural life, most of them are more or less diseased, especially the fat ones. The excess of nitrogen taken into the system in eating flesh meat has to be got rid of by the liver, kidneys, and lungs; hence these organs are overtaxed, and much disease is the consequence. In fact, were it not for flesh food we doctors should have very little to do. Man living in towns cannot afford to eat much flesh, because he does not get sufficient exercise and oxygen to burn up the excess of nitrogen. If he does eat this flesh, and if he eat much, then he must suffer from many complaints, such as indigestion, bilious attacks, congested liver, hæmorrhoids, gastric catarrh, and other gastric troubles. If the habit be continued in, gall-stones or urinary calculi may follow, or rheumatism and gout. Then the kidneys become diseased and more work is thrown on the heart, which becomes also diseased; the end is death by one of the lingering diseases, which shows a diseased organ somewhere. Even epilepsy and many nervous diseases are aggravated by flesh. Cancer is on the increase, and, from some observations I have made, it may be

* From a letter to the *Times* by our valued correspondent, T. R. Allinson, L.R.C.P.

indirectly traced to flesh. Consumption has only a remote connection with flesh, it being due chiefly to want of fresh air. Vegetable food is cheap, contains an abundant supply of nutriment at first cost, and our systems are so formed as to use it with least expenditure of vital force. We use no cruelty in obtaining our food, and can easily see if it be wholesome or in a rotten state.

By means of our diet much disease is prevented, and even most chronic cases of present disease can be alleviated by it. If we want a cheap dietary we have the following foods to choose from:—Wheat, oats, barley, maize, rice, sago, tapioca, semolina, hominy, peas, beans, lentils, &c., which are all concentrated foods, and very rich in nutriment. Potatoes, parsnips, beets, carrots, turnips, onions, cabbage, sprouts, &c., give variety, bulk, and flavour; to these may be added the sweet herbs for making savoury dishes. Apples, pears, currants, gooseberries, plums, strawberries, rasps, blackberries, and other fruits, with melons, peaches, grapes, &c., are high-priced, but wholesome fruits. The dried fruits, as dates, figs, apple rings, currants, raisins, &c., are cheap and good. To these may be added tinned goods. Thus one can see the immense variety of tasty things we have, and these to suit all purses. We can add to these milk, butter, cheese, eggs, and honey, which are got without killing animals. But if we take animal food, then fish is least injurious, then beef and mutton, while veal, pork, game, &c., are very indigestible, and ought to be avoided.

RECREATION THROUGH UNCERTAINTY.*

IF we look for the characteristics which may be found in all good active recreations, and on which their utility chiefly depends, we shall find that they all include one or more of these three things: namely, uncertainties, wonders, and opportunities for the exercise of skill in something different from the regular work. And the appropriateness of these three things seems to be, especially, in that they provide pleasant changes which are in strong contrast with the ordinary occupations of most working lives, and that they give opportunity for the exercise of powers and good dispositions which, being too little used in the daily business of life, would become feeble or be lost.

In their daily work—speaking generally and roughly—most people become tired of routine and sameness; they know their business, and there is in it little to surprise them; they can reckon on what is coming; they know how and when each day's work will end. They get tired of all this, and wish for something very unlike it; and so they long for uncertainties; they enjoy to watch something they are not sure of, to see the settlement of a doubt, the unveiling of a mystery.

Herein is a great part of the refreshing change, the recreation, found in games of chance. The toss of a halfpenny brings refreshment to the routine of the school-boy or the errand-boy in that every time he tosses he creates an uncertainty, enjoys it for a moment, and then decides it. To the elder man the deal at whist and every hand he plays bring similar pleasure in uncertainties; and the counting of the tricks decides them; and the pleasures and uncertainties accumulate to the end of the rubber or of the whole evening's play. Other pleasures mingle with these; the exercise of skill, the reckoning of chances, and many more, including, perhaps, the winning of money or repute; but with them all and under them is the occupation in uncertainties, and its pleasure is the more refreshing the more it is in contrast with sameness in the daily work.

Doubtless there is much of the same pleasure in all sports; in fishing, shooting, and the like. Will the fish bite? Will the bird fall? There is the uncertainty; and then comes the decision; and in any case, hitting or missing, the mind which has been wearied in a dull routine is refreshed. It is the same in cricket and lawn-tennis, and all the like popular games. Mingling with the other pleasures that they give, and the other good they do, there is the refreshing pleasure of a continuous succession of uncertainties and decisions, a pleasure which seems to reach its acme in some of the amusements that are attended with frequent risks of limbs or even of life. The contrast with the ordinary occupations of vast crowds of all ranks and ages and occupations is complete; and from this contrast comes a great part of the true recreation, the re-fitting for the work. Doubtless, some of the refreshment of reading novels and romances, whether real or in fiction, is of the same kind. Else, why should nearly every one who reads them feel that his pleasure is marred by hearing what the end of the story is, and by thus having his uncertainty prematurely settled?

These may be examples enough. I believe that if any one will think over the whole class of what are fairly called active recreations, he will find that a chief part of nearly every one is of this kind: the unveiling of a mystery, the issue of some chance, the settlement of an uncertainty. Every one who works enough to need or deserve refreshment should see that some of his recreations have in them this element; and let him observe that of all the recreations of this kind those are the best which, together with the element of uncertainty or chance, offer the largest proportion of that element of which I spoke—the opportunity of exercising skill. In all games and sports the more the results depend on chance, and the less they depend on the skill of the players, the more is the gambling. Duly guarded, the love of recreation among uncertainties may lead to the promotion of admirable skill, whether of mind or limbs; and if, on the one side, it may make itself vile by gambling, on the other it may ennoble itself by strengthening the mental disposition which moves men to experiments in science, and even to the highest methods of research. In all these a great part of the happiness is in the watching and decision of uncertainties, in the unveiling of hidden truth; and all whose work gives them too little opportunity for such happiness should have it in their play.

* From an article by Sir James Paget in the *Nineteenth Century*.

THE AMATEUR ELECTRICIAN.

BATTERIES VII.

A HANDY form of bichromate battery, in which the solution is kept in motion, is that constructed by Mr. Higgins, of the Exchange Telegraph Company. Its distinctive feature is in the earthenware containing-jar, which is supplied with a small lip on the upper edge. The cells are arranged on a series of shallow steps, and are placed as close together as possible. Above the highest cell is a small tank or reservoir containing the solution, which is discharged drop by drop. As the drop falls into the cell, a drop is expelled from it into the next cell below it, and similarly the second cell discharges a drop into the third cell. In this way there is accomplished a continuous motion in each cell, and it is maintained that there is a considerable increase in the constancy of the cell in conse-

quence. Whether, however, it is sufficient to warrant structural alterations in the battery room or not is, perhaps, an open question. It will answer many purposes to which the amateur wishes to apply his battery, more particularly in those cases where a powerful and approximately steady current is required.

M. Trouvé has also tried to increase the constancy or steadiness of the current from a single fluid bichromate. He turned his attention to the solution, which is prepared by dissolving three ounces of bichromate of potash in twenty ounces of boiling water, and, after cooling, adding gradually nine ounces of sulphuric acid, stirring the solution as the acid is introduced. A stronger solution is in this way prepared, and, according to M. Hospitalier, the current is steadily maintained for five hours if the zincs are gradually immersed deeper and deeper in the solution. No sane man would, however, maintain that such an arrangement could be regarded as a practical one—one, that is to say, which could be called upon at a few minutes' notice to do work either on a small or on an extensive scale. The intensity of the current is but two volts per cell; less, that is, than can be obtained from another form, to which we shall now turn.

When Gerritt Smith arrived in England for the purpose of trying the American system of quadruplex telegraphy, it was found that the Daniell cell—which till then had enjoyed almost exclusive tenancy of the Post-office battery-rooms—would not, unless subjected to very extensive modifications in size, yield a current such as would work the system efficiently. The form of cell used in America was unsuited to English ideas. The result was that resort was made to a cell offered by Mr. Fuller, and which bears his name. Several thousand Fuller cells are in use throughout the country, there being no fewer than seven thousand in the Central Telegraph Office alone. Fig. 1 illustrates

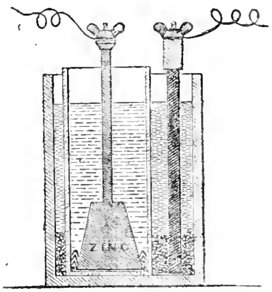


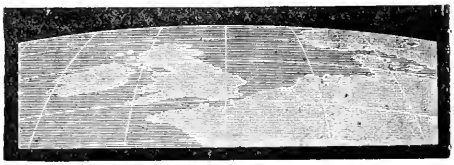
Fig. 1.

the construction of the cell, which consists of a zinc rod of peculiar shape, cast on to a thick copper wire, placed in the porous pot, and a small carbon plate capped with lead and fitted with a binding screw in the outer or containing earthenware jar. The shape given to the zinc is to compensate for unequal consumption, and to facilitate its amalgamation, which is brought about automatically. The comparatively large size of the outer vessel, which is generally 6 inches high and 4½ inches in diameter, while the carbon is only 2 inches, is to allow a large quantity of bichromate solution to be employed, and so to save time in renewing or recharging, and to minimise polarisation. The cell is charged by placing in the porous pot dilute sulphuric acid in the proportion of nine of water to one of acid, and in the outer jar a strong solution of bichromate of potash, with about 10 per cent. of sulphuric acid added. Great as is the stir made when we are told that certain batteries are constant for four, five, or six hours, the Fuller cells are frequently called upon for longer periods. In quadruplex telegraphy a current is always on the line—that is to say, so long as the circuit is being worked; and thus it is that the cells are giving a practically uninterrupted current from 7 a.m. till 6 p.m., or perhaps later, day after day for weeks, without requiring any serious attention. It is, of course, only fair to point out that the resistance offered by a telegraph circuit is as a rule much higher than in experimental circuits, a fact which operates very materially in favour of the battery, because with a circuit of very low resistance—say half a mile of copper wire of about the same thickness as a common pin—the current is proportionately larger, or capable of producing greater thermal effects, and the battery, as a consequence, is more speedily exhausted.

Where delicate apparatus is employed, or where the battery circuit is frequently broken and re-made, considerable danger results from the use of batteries of low resistance. For example, it frequently happens that 40, 60, and even 80 cells are used on a circuit, the resistance of which is, perhaps, 5,000 Ohms, or more. Supposing, now, that the wire suddenly breaks and falls to the ground, or that some other of the many ills that an aerial telegraph line is heir to takes place, then the battery, if the fault happens to be close up, will be practically short-circuited, the current immensely increased, and the platinum contacts in the instruments fused; or, if any coils happen to be in the circuits, as is the case in some systems, they stand a good chance of being fused, and so rendered useless. To prevent this as far as possible, the porous pots used in the telegraph service are painted with a very thin coating of an insulating material, so as to raise the internal resistance of the cell to 2 Ohms.

We should have said something concerning the latest of the many proposals to use bichromate batteries for electric lighting, but this we must defer till another opportunity presents itself.

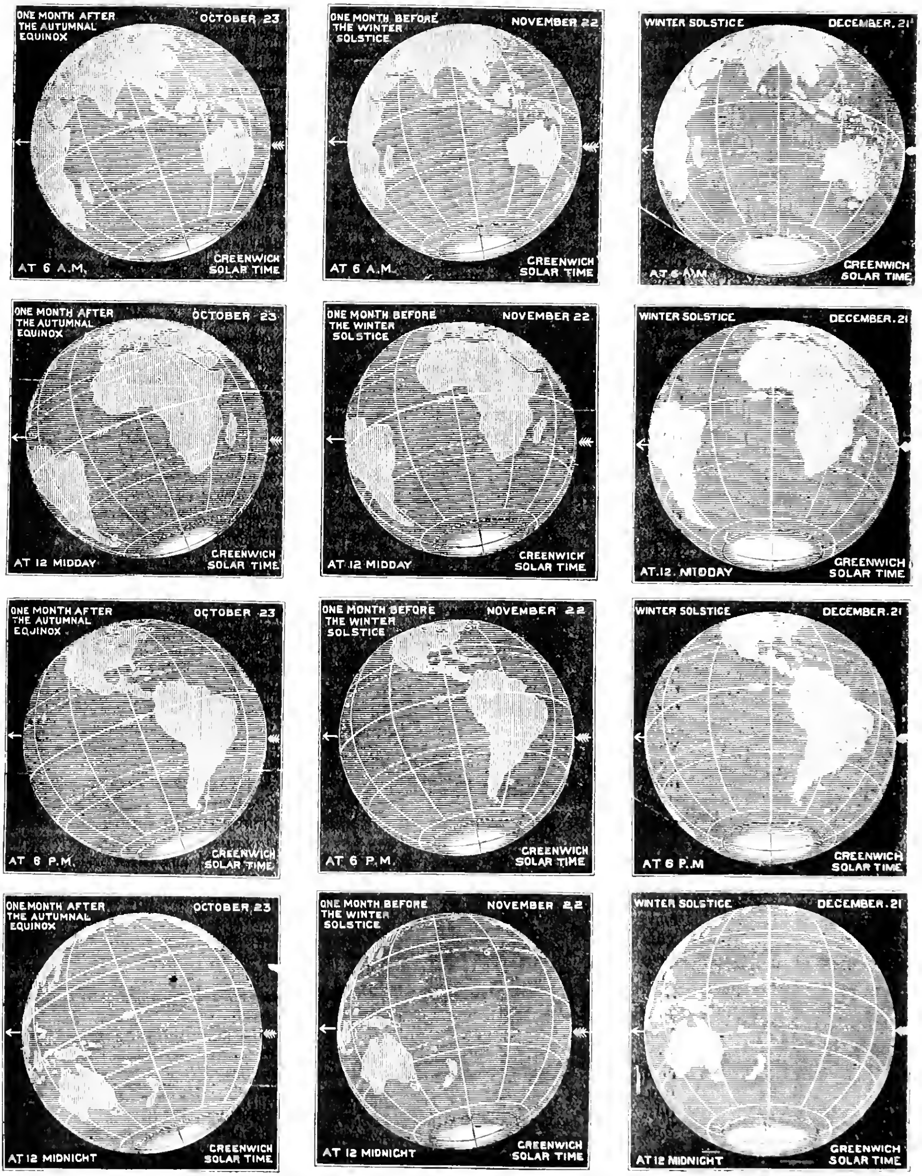
SUN VIEWS OF THE EARTH.



View of the British Isles, France, &c., as seen foreshortened from the Sun in Winter.

National Health Society.—At a meeting of the society on the 11th inst. it was decided to assist, as far as possible, the useful work now carried on by the Sanitary Aid Committee. These are being started in several parts of London in connection with the local committee of the Charity Organisation Society. The National Health Society will issue shortly a handbook for the use of sanitary-aid visitors, explaining in simple terms the existing laws between tenants and landlords, and the leaflets and pamphlets already published by the society will also be of great service.

One Month after Autumnal Equinox. One Month before Winter Solstice. At the Winter Solstice.



SUN VIEWS OF THE EARTH;
OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

I GIVE this week the Sun Views for the month, showing the aspect of the earth as supposed to be seen from the sun at six in the morning, noon, six in the evening, and midnight, Greenwich solar time, at the winter solstice. For comparison, the Sun Views of October and November are repeated. We add a picture of the British Isles, &c., as seen from the Sun at the Winter Solstice.

SCIENCE AND SAFETY AT SEA.

By Richard A. Proctor.

IN the Autumn of 1879 the steamship *Arizona*, 5,000 tons, at that time the swiftest ocean-going steamship in existence, was urging her way, at the rate of some fifteen knots an hour, on the homeward course from New York, whence she had sailed but a day or two before. It was night, and there was a light haze, but of danger from collision with a passing ship there was little or none. The captain and crew knew of no special reason for watchfulness, and the passengers were altogether free from anxiety. Indeed, it so chanced that at a time when, in reality, the most imminent danger threatened every soul on board, many of the saloon passengers were engaged in purchasing at auction the numbers for the next day's run—runs below 350 knots being sold at a very low rate indeed. Suddenly a crash was heard, the ship's swift progress was stopped, and a few minutes later every one knew that the *Arizona* had run dead upon an enormous iceberg, the spires and pinnacles of which could be seen hanging almost over the ship, and gleaming threateningly in the rays of her masthead light. But the risk that threatened her living freight was not that of being crushed by falling ice. The bows of the *Arizona* were seen to be slowly sinking, and presently there was a well-marked lurch to starboard. The fore compartment and a smaller side compartment were filling. It was an anxious time for all on board. Many an eye was turned towards the boats, and the more experienced thought of the weary miles which separated them from the nearest land, and of the poor chance that a passing steamer might pick up the *Arizona's* boats at sea. Fortunately, the builders of the *Arizona* had done their work faithfully and well. Like another ship of the same line which had been exposed to the same risk, save that her speed was less, and, therefore, the danger of the shock diminished, the *Arizona*, though crippled, was not sunk. She bore up for St. John's, and her passengers were taken on later by another steamer.

The danger which nearly caused the loss of the *Arizona*—collision with an iceberg—is one to which steamships, and especially swift steamships, are exposed in exceptional degree. Like this danger, also, it is one which renders the duty of careful watching, especially in the night and in times of haze or fog, a most anxious and important care. But, unlike the risk from collision with another ship, the risk from collision with icebergs cannot be diminished by any system of side lights or head lights or stern lights, except in just such degree (unfortunately slight) as a powerful light at the foremasthead, aided by strong side lights or bow lights, may serve to render the gleam of the treacherous ice discernible somewhat further ahead. But to a steamship running at the rate of fourteen or fifteen knots an hour, even in the clearest weather, at night, the distance athwart which which a low-lying iceberg can be seen, even by the best eyes, is but short. She runs over it before there is time for the watch to make their warning heard and for the engineers to stop and reverse their engines.

But science, besides extending our senses, provides us with senses other than those we possess naturally. The photographic eyes of science see in the thousandth part of a second what our eyes, because in so short a time they can receive no distinct impression at all, are unable to see. They may, on the other hand, rest on some faintly luminous object for hours, seeing more and more each moment, where ours would see no more—perhaps even less—after the first minute than they had seen in the first second. The spectroscopic eyes of science can analyse for us the substance of self-luminous vapours, or of vapours absorbing light, or of liquids, and so forth, where the natural eyes have no such power of analysis. The sense of feeling, or rather the sense for heat, which Reid originally and properly distinguished as a sixth sense (not to be confounded, as our modern classification of the senses incorrectly confounds it, with the sense of touch), is one which is very limited in its natural range. But science can give us eyes for heat as keen and as widely ranging as the eyes which she gives us for light. It was no idle dream of Edison's, but a thought which one day will be fraught with useful results, that science may hereafter recognise a star by its heat, which the most powerful telescope yet made fails to show by its light. Since that was said the younger Draper (whose loss followed so quickly and so sadly for science on that of his lamented father) has produced photographic plates showing stars which cannot be seen through the telescope by which those photographs were taken. As yet the delicate heat-measurers devised by science have not been applied to astronomical research with any important results. But Edison's and Langley's heat-measurers have been used even in this way, and the very failure which attended the employment of Edison's heat-measurer (the tasimeter, or, literally, the strain measurer, described shortly before in the *Times*) during the eclipse of 1878 shows how delicate is the heat-estimating sense of science. When the light of the corona — which has no heat that the thermometer, or even that far more delicate heat-measurer, the thermopile, will recognise—fell on the face of the tasimeter the index which Edison supposed likely to move just perceptibly actually flew beyond the index-plate. Thus, though the heat of the corona could not be measured, the extreme delicacy of the tasimeter was demonstrated unmistakably. Langley's heat-measurer is scarcely less sensitive, and probably more manageable. But in point of fact each instrument is more sensitive than the heat sense of science is required to be, to do the work I have now to indicate; and an instrument can readily be constructed which shall be, in the right degree, less sensitive than they are, though it might be difficult at present to invent any that should be more sensitive.

The sense of sight is not the only sense affected as an iceberg is approached. There is a sensible lowering of temperature. But to the natural heat sense this cooling is not so obvious or so readily and quickly appreciated that it could be trusted instead of the outlook of the watch. The heat sense of science, however, is so much keener that it could indicate the presence of an iceberg at a distance far beyond that over which the keenest eye could detect an iceberg at night; perhaps even an isolated iceberg could be detected when far beyond the range of ordinary eyesight in the daytime. Not only so, but an instrument like the thermopile, or the more delicate heat-measurers of Edison and Langley, can readily be made to give automatic notice of its sensations (so to speak). As those who have heard Professor Tyndall's lectures any time during the last twenty years know, the index of a scientific heat-measurer moves freely in response either to gain or loss of heat, or, as we should ordinarily say, in response either to heat or cold. An index which thus moves can be made, as by closing or breaking electrical contact, or in other ways, to give very effective indication of the neighbourhood of danger. It would be easy to devise half a dozen ways in which a heat indicator (which is of necessity a cold indicator), suitably placed in the bows of a ship, could note, as it were, the presence of an iceberg fully a quarter of a mile away, and speak

of its sensations much more loudly and effectively than the watch can proclaim the sight of an iceberg when much nearer at hand. The movement of the index could set a fog-horn lustily announcing the approach of danger; could illuminate the ship, if need be, by setting at work the forces necessary for instantaneous electric lighting; could signal the engineers to stop and reverse the engines, or even stop and reverse the engines automatically. Whether so much would be necessary—whether those among lost Atlantic steamships which have been destroyed, as many have been, by striking upon icebergs, could only have been saved by such rapid automatic measures as these, may or may not be the case; but that the use of the infinitely keen perception which the sense organs of science possess for heat and cold would be a feasible way of obtaining much earlier and much more effective notice of danger from icebergs than the best watch can give, no one who knows the powers of science in this direction can doubt.—*Times*.

Editorial Gossip.

I regret to say that two members of the Faculty, to wit my family doctor and a doctor specially skilled in matters relating to railway accidents and their effects, regard with disapproval the efforts I have made during the last few months to disregard Nature's warnings. The fact is, the London and South-Western Railway Company have endeavoured so earnestly to persuade me that I am none the worse for the shock they kindly gave me last July that I have tried to persuade myself I might not be so much the worse for it as I seemed to feel. Anyway, I am now relegated to two months, at least, of absolute repose from mental work. Fortunately, there is enough collected material, so far as my share in Knowledge is concerned, for longer than that; and I believe readers will find no other effect but the omission of "Short Answers" and "Editorial Gossip"—perhaps (if some correspondents are to be believed) an improvement rather than otherwise. I shall ask those who stand by Knowledge to continue their support till I am fairly on my feet again. That they have done so, indeed, during the last few months, when I have been as good as on my back (or as bad?), says much for their good will.

Some physical results of the Java disturbance help us to understand how small the world is. Take a bowl of water, agitate the fluid in the centre, and the undulations you excite propagate themselves in smooth-swelling concentric rings till they lap against the sides of the bowl. There they break, and slop up in mimic tidal waves. This is an exact illustration—*magna componere parvis*—of the oscillations of the sea reported from both hemispheres this week. The tidal irregularities, as might be expected, were most violent on the north-western seaboard of Australia, which lies right opposite the scene of the Java disturbances. On that coast the sea retreated and advanced a hundred yards. A day or two later oscillations appeared on the Atlantic seaboard of America. The particular undulation which, on the fifth day out, slopped up on the East coast of New Zealand, must have come by way of the Cape of Good Hope and Cape Horn, and had nearly completed the circuit of the globe. Australia lies as a breakwater between us and Java by the direct route. It gives one a new conception of the littleness of what Henry Ward Beecher calls "this fipenny-ha'penny world" when a man can stand on the Ocean Beach at Dunedin and watch the ripples from a splash made in the Straits of Sunda.—*Otago Times*.

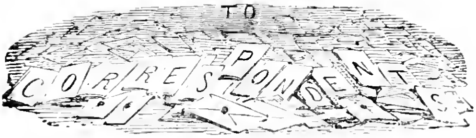
THE FACE OF THE SKY.

From December 20, 1883, to January 4, 1884.

By F.R.A.S.

Whenever the winter sky is sufficiently clear, the Sun should be examined for spots. The mist near the horizon will now often enable this to be done with a very light coloured eye-shade on the telescope. Map XII. of "The Stars in their Seasons" exhibits the present appearance of the night sky. Mercury is still, for all practical purposes, invisible, as is Venus also. The position of Mars improves nightly, as he rises soon after eight on December 20, and about seven o'clock in the evening by January 4. By the latter date his diameter will have increased to 15″. He is still perceptibly gibbous, *i.e.*, as we have previously explained, not round. He continues in the western part of Leo ("The Stars in their Seasons," Map. III.). Jupiter, the gem of the night sky, rises about 6h. 22m. this evening, appearing above the horizon, of course, earlier and earlier every night; until by the 4th prox. he rises at 5h. 24m. p.m. His diameter increases during this interval from 41″·7 to 42″·6. He continues in Cancer, at some little distance to the west of the Præsepe (same Map). The phenomena of his Satellites visible before 1 a.m. during the next fourteen days are tolerably numerous. And first, to-night, the young observer should carefully watch as much of the Transit of Satellite IV. across Jupiter's face as he can. The Satellite will leave Jupiter's disc at 11h. 5m. p.m. We have referred on page 350 to the curious phenomena often witnessed in connection with the Transits of the outer Satellites, and less frequently seen when the inner ones cross Jupiter's face. On the 21st, Satellite III. will disappear in eclipse at 34m. 48s. after midnight. The shadow of Satellite I. will enter on to the planet's limb on the 23rd, at 10h. 22m. p.m., followed by the Satellite which casts it at 11h. 1m. p.m. The shadow will pass off at 12h. 42m. p.m., the Satellite not until between 1 and 2 o'clock the next morning. The next night (the 24th), the same Satellite, I., will disappear in eclipse at 7h. 33m. 44s., pass behind the body of the planet, and reappear from occultation at 10h. 29m. p.m. On the 25th Satellite I. passes off the limb of the planet at 7h. 47m. p.m.; as does Satellite III. at 8h. 35m. Satellite II. disappears in eclipse at 8h. 39m. 24s. p.m. on the 26th, to reappear from occultation 43 minutes after midnight. On the 28th, Satellite IV. will suffer eclipse at 9h. 40m. 21s. p.m. Sixteen minutes after midnight on the 30th the ingress of the shadow of Satellite I. will begin, the Satellite following it half an hour later. On the 31st, the same Satellite will disappear in eclipse at 9h. 27m. 25s. p.m., reappearing from occultation at 12h. 13m. The night of January 1, if fine, will be a prolific one for the student. The ingress of the shadow of Satellite I. will occur at 6h. 45m., followed by that of Satellite I. itself at 7h. 12m. p.m. The transit of Satellite III. will begin at 8h. 20m.; the shadow of the 1st Satellite leaves Jupiter's face at 9h. 4m., as will the Satellite casting it at 9h. 32m. Then the shadow of Satellite III. will quit the limb of the planet at 10h. 4m., Satellite III. itself passing off at 11h. 55m. On Jan. 2 Satellite I. will reappear from occultation at 6h. 39m. p.m., and Satellite II. be eclipsed at 11h. 15m. 28s. Lastly, on Jan. 4 the egress of the shadow of Satellite II. will happen at 8h. 19m., as will that of the Satellite from which it proceeds, at 9h. 6m. p.m. Saturn is still visible during the whole of the ordinary observer's night. He rises this afternoon (the 20th) about 2h. 23m., and is on the meridian at 10h. 16·9m. p.m. By Jan. 4 he will south at 9h. 14·0m. in the evening, rising about 1h. 27m. in the afternoon. All the leading details of his physical structure are now admirably visible with sufficient optical power. Uranus will scarcely come within the ken of the great mass of amateur observers before February next. The direction we gave a fortnight ago (p. 350) will enable any one to find Neptune who cares to do so. Pons's Comet is now brightening with tolerable rapidity, and may be seen with the naked eye. If we draw an imaginary line between γ and 35 Cygni, the Comet to-night will be very nearly on this line, about three-quarters of the distance between the larger star and the small one. It will be close to ζ Cygni on the 27th. By Jan. 4 it will have travelled down into Pegasus. The Moon's age at noon to-day is 20·7 days; and, evidently, at the same hour on Dec. 29, 29·7 days. Then she will be one day old on the 30th at noon; and, of course, six days old at noon on Jan. 4. She will not rise to-night until a quarter to twelve o'clock; and, as she does so later and later every day, the nights up to the end of the year will be practically moonless. No occultations of stars occur during our specified period. The Moon is travelling across the south-eastern part of Leo to-day, and enters Virgo at midnight. It takes her until 11 a.m. on the 24th to cross this large constellation, and at that hour she passes into Libra. Her passage through Libra occupies 48 hours, and at

11 a.m. on the 26th she enters the narrow strip which forms the northern part of Scorpio, and having crossed this, at 11 p.m. enters on to her path through the southern part of Ophiuchus and Serpens. By 6 p.m. on the 28th she quits Serpens for Sagittarius, whence she passes, at 5 a.m. on the 31st., into Capricornus. At midnight on the last night of the year she enters Aquarius. She does not leave Aquarius until about 7 p.m. on January 3rd, when she travels into Pisces. We there leave her.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

A BLUE MOON.

[1056]—On December 4, at 4.30, p.m., I was summoned by an observant assistant (Mr. T. H. Dean) to see a "blue moon!" Sure enough, the moon's crescent was of a steely, greenish-blue—"electric blue," I believe the precise tint is called. The setting sun was marked by coppery-red stratus clouds; elsewhere cumulus prevailed, with patches of blue sky. The phenomenon only lasted for some ten or fifteen minutes. I should attribute it to matter (capable of absorbing the red rays) suspended in the upper regions of the atmosphere. The sun's rays having to pass twice through these upper layers of air, were reduced at last to the blue end of the spectrum only. That most of this finely-divided, suspended matter may have been derived from the fearful volcanic eruptions which occurred some time back in the East Indian Archipelago, I have no reason to doubt. At least, I have not yet heard of any more feasible theory. W. Jerome Harrison.

36, Lodge-road.

[The theory that the blue and green sun and moon and recent strange sunsets have been due to the volcanic eruptions near the Sunda Straits, requires,—(1), that much more should have been expelled than was apparently expelled (to spread so widely); (2), that to reach Trinidad, Panama, and Yokohama the expelled matter should have travelled from sixty-five to seventy-five miles per hour, but have gone in quite leisurely fashion to Ceylon and South India. I fancy we all thought Krakatoa had something to do with the matter when we had the news from Ceylon. But now I think every one who has studied the evidence in full and is competent to form an opinion perceives that the theory has become altogether untenable. Professor Piazzi Smyth, I see, holds as Mr. Ranyard does, that meteoric dust explains all the phenomena.—R. P.]

STRANGE SUNSETS AND BLUE MOON.

[1057]—Pardon me intruding on your time, and perhaps on your space, but might I suggest a use of aeronautics to solve, perhaps, to some extent, the at present insoluble recent solar and lunar phenomena? We know how Gay-Lussac and Biot in 1802, and afterwards Gay-Lussac himself, at a height of 22,000 ft. above Paris, or four miles and a quarter above the level of the sea, intrepidly experimented on magnetism, hygrometry, &c. Whatever the dust pervading the space contiguous to our earth may be, surely at such a height some of it might be collected and examined in the same way as atmospheric dust has been collected and examined, as described in a past article in Knowledge. Is there no one of those who make aëronautic voyages as a pleasure who will place their experience and apparatus at the disposal of scientific men—that is to say, if they think such a course likely to meet with any success?

Unluckily Mr. Raynard's article appeared just after the first fall of snow, with his suggestion to analyse it, in order to ascertain whether a greater quantity of dust were present than usual. I trust that he has done so, and will give us his results.

In that unsatisfying article in the *Daily News* of the 8th inst. the writer has attempted to explain the green moon by the pinkish colour of the sky beyond it. A friend of mine, however, at Red Hill, states that he saw the crescent moon green on Wednesday, 5th inst., at 5.10 p.m. on the ordinary starry background, and *not* on a pink background. He says that as it sank in the west it assumed the reddish colour. Edward A. Martin.

STRANGE SUNSET.

[1058]—At Montrose, as at other places, the remarkable "afterglow" has been observed, and the following observations of it at Montrose may prove interesting to Mr. A. C. Ranyard and your readers.

1. I observed it first here on the evening of Sunday, Nov. 25, when the sky was filled with a deep red colour, looking very like (as I at first supposed it to be) a very bright Aurora. The glow continued in the sky at every sunset, with more or less intensity, for the whole week, and on Nov. 30 it attained its maximum (so to speak), for, just as the sun set, the whole sky was filled with colours of the most brilliant hues: on the horizon was a band of bright yellow streaked across its centre transversely by another of green, while overhead the sky was of an orange colour, gradually merging into brilliant red. That same morning a "preglow" of as great intensity as the afterglow was observed. For the next three days, Dec. 1, 2, 3, it was foggy and dull, and on the evening of the 3rd and morning of 4th there was a heavy fall of snow. For the rest of that week there was clear, hard weather, with occasional snowfalls, and the afterglow disappeared entirely, the sun rising and sinking quite clearly.

2. On the morning of Sunday, Dec. 9, the weather changed, the snow melted and rain fell. In the evening the afterglow was visible again, commencing about fifteen minutes after the sun had set, and continuing for nearly an hour. This time I observed that the colour of the sky overhead was not red, but of a brown orange tint, and it also seemed to be more scattered. This morning (10th) there was a beautiful "preglow," which was observed about an hour before sunrise, the colours being the very same as those of the evening before.

3. I have observed that a very black bank of cloud usually stretches along the horizon, from west to east, whenever a glow is visible. The upper edge of this cloud is very remarkable, being extremely straight, and pointed towards the west.

Now, I would like to ask a few questions. Could the rays of the young moon (which was high in the sky at sunset last week) have affected the glow and rendered it invisible? Could the rain or the snow have brought the dust nearer the earth, and so account for the orange colour visible overhead last evening, the orange rays being shorter than the red? or could the phenomenon be attributed to ice-particles floating in the higher regions of our atmosphere?

James B. Findlay.

SUN-SPOTS AND COMET.

[1059]—It may interest some of your readers, who have not good telescopes, to know that a large number of spots can be seen with only a small instrument. I use a telescope only 1 ft. long, with an object-glass 1 in. in diameter; on forty days on which I have been able to observe—from Oct. 21 to Dec. 11—I have seen about 150 different spots; on three days, Dec. 4, 5, and 6, no spots were visible. On Nov. 14, 18 were visible; to-day (Dec. 11) 12 are visible, of which three can be seen by the naked eye.

The comet has been visible to the naked eye for about a fortnight.

Northcote W. Thomas.

COINCIDENCES.

[1060]—I think the following adventures of a bank-note equal the wanderings of your correspondence as recorded in Knowledge of the 16th inst. A subordinate in a Government office stationed on an island off the coast of Ireland was entrusted with a bank-note for which he was to get cash at a bank on the mainland. He crossed the water, paid some visits to other offices where he had letters to deliver, and arrived at the bank only to find that the note was gone. Inquiry was made at the offices where he had called, but no trace of the note could be found, and Timothy (for so I will call him) returned almost in tears to the island. Every effort was made to discover the missing note—for no one doubted the honesty of the subordinate. The priest even mentioned the circumstance at the services, which amongst a Catholic community sometimes has a result. To make a long story short, the note remained undiscovered for six months, when one day it was received

by another subordinate (call him Brown), serving in another department on the island, enclosed in a letter from his son in England. The adventures of the note then came out. Timothy, being a careful man, had put the note in an ordinary official envelope, headed "On Her Majesty's Service," and deposited both in his pocket. In delivering his letters at one of the offices on the mainland he had drawn out the envelope containing the note, which fluttered to the floor, and lay there for some time unobserved. The office-keeper, in cleaning out the office next morning, picked up the envelope, and seeing it was an unused one placed it in the stationery-rack with others of the same sort. Brown, who represented this office on the island, found in time that his stationery had run out, and sent over to the head office for more. A supply was made up, and included the identical envelope which still faithfully guarded the note. Subsequently Brown had occasion to write to his son, and not having a private envelope at hand took an official one, picking out the one in which the note still lay undiscovered. The son on opening the letter found the note, and, being an honest lad, returned it to his father. The points that strike one as remarkable in this incident are—1. That the envelope should have been dropped by Timothy without any one noticing it. 2. That it should lie unobserved till found by the office-keeper. 3. That he should not have looked into it. 4. That it should have gone back to the island. 5. That Brown should have used it for a letter going to England. 6. And that he should not have discovered the note. I may add that the note must have had hundreds of escapes from falling into dishonest hands. C. A. E.

[1061]—Your article on coincidences reminds me of one which you may be glad to add to your list. It is striking, literally, to say the least.

An uncle of mine was a rather fine amateur painter, and as he always presented his pictures in handsome frames, his gifts were usually very acceptable. One of them went to the country, I need not say where, but miles away from the town in which he lived, and was placed in the gentleman's drawing-room, which happened to be over the dining-room. One day whilst at luncheon the family were aroused from their meal by a tremendous report of a falling body in the room above, immediately followed by the crashing of glass. Hastily rushing upstairs into the drawing-room, they found the picture had fallen in such a peculiar manner as to scarcely injure the lower part of the frame, but to utterly smash —more especially in one spot—the uppermost portion. The owner remarked to his wife how strange the picture should have thus fallen to cause so strange a fracture, and added he hoped nothing could have happened to the donor, which idea was laughed at by others present. . . . . . That day, and that hour, and as near that minute, my uncle fell down in a fit in the street, not injuring his feet or legs, but striking the curbstone, fractured the skin of his head, and well-nigh his frontal bone—he died at once.

Another F.R.A.S. Subscriber.

SILENT LIGHTNING.

[1062]—With reference to letter 1003, p. 308, in the evening of June 29 last I watched the path of a heavy thunderstorm from S.W. to N.E., which at its nearest point was about ten miles distant. As the thundercloud covered a large area, and the lightning was at different points, I was unable to estimate the exact limit of audible thunder, but at 8 p.m., and for ten minutes later, the thunder of every flash was distinct, and I judged the limit roughly at fifteen miles. The wind here was light, from S.W. The lightning was seen, as is frequently the case here, long after the thunder ceased to be heard. The direction and force of the wind seem to affect the distance of hearing.

Rectory, Worcester. F. S. L.

SILENT LIGHTNING.—LUMINOSITY OF ANIMALS.

[1063].—I have met with two remarkable instances of long-continued lightning, unaccompanied by thunder. Once, at Shanghai, in July, the sky was illuminated with one incessant unintermittent glare, lasting several hours, but no thunder was heard. But the most remarkable instance occurred in May, off the south-coast of Madagascar, when, from 7 to 11 p.m., I watched a glare, which left the sky dark only for a second once in an hour or so, the central point of which seemed elevated 10° or 15° above the horizon. As the nearer clouds cleared away, I watched for hours the unceasing flashes, tongues of fire darting out round the distant clouds, radiating in five or six distinct streams of flame from a given point, like the thunderbolt in the hand of Jove, coursing along the sky, or dashing down into the sea at the horizon like liquid fire; yet all the while not a sound was heard. After I had retired, at 11, I still saw, as long as I lay awake, the reflection playing upon the walls of the cabin as from a flickering lamp. The day following was marked by a brilliancy of atmosphere and freshness of temperature not before experienced. On this, and another occasion at Sarawak, the lightning was unusually vivid, but the flashes were not simple instantaneous sparks, but had the appearance of liquid fire poured from a vessel in a continuous stream, and lasting a definite time, during which the lightning vibrated upon the retina, the zigzag form of the flash, however, being meanwhile perfectly retained.

In my "Rambles of a Naturalist in the China Seas" may be found a chapter upon the Luminosity of Animals, the result of many months' continuous observation, containing also suggestions as to its origin. The chapter ends with this remark: "If we were called upon to specify in what classes of animals it (luminosity) has been observed, we should prefer to make a converse statement, to the effect that, with the sole exception of birds, every class of animals includes representatives, which, under certain circumstances and conditions, have been proved to be capable of giving out light." C. Collingwood.

FIGURE MAGIC—CURIOUS MULTIPLICATION.

[1064]—Taking first the case where nothing is added (letter 974, page 262), it is easily seen that multiplying by 3 and 3 and dividing by 2, 2, and 9 is equivalent to dividing by 4 $\left(\text{for } \frac{3 \times 3}{2 \times 2 \times 9} = \frac{1}{4}\right)$ which accounts for the final multiplication by 4 in order to arrive at the original number. The example given (in which the first of the "trebled results" is odd) is rather more difficult to unravel. A little consideration, however, shows that the 1 added is subsequently multiplied by 3 and divided by 36, and the resulting $\frac{1}{12}$ is discarded in the $\frac{1}{3}$ after dividing by 9 ($93\frac{1}{3}$ being the full quotient). It is therefore evident that after multiplying by 4 the result is $(\frac{1}{3} - \frac{1}{12}) \times 4 = 1$ too little. Hence the necessity for the final addition of 1.

It follows from the rule that any similar example (*i.e.*, with first odd and then even trebled results) must have a remainder with a fraction of $\frac{1}{3}$ after dividing by 9. From which we can infer that only those numbers will yield first odd and then even trebled results, which, when multiplied by $\frac{3 \times 3}{2 \times 2 \times 9}\left(= \frac{1}{4}\right)$, and increased by $\frac{1 \times 3}{2 \times 2 \times 9}\left(= \frac{1}{12}\right)$, give a remainder with a fraction of $\frac{1}{3}$. Deducting the $\frac{1}{12}$ the fraction is $\frac{1}{4}$; therefore the numbers which will yield odd and then even results, are those which are one in excess of the multiples of 4. Similar considerations will show the reason for the cases in which 2 and 3 are to be added.

I should like very much to learn how "A. B." arrived at his curious rule for multiplication in certain cases (letter 973). It seems to have some connection with the ordinary *working* of multiplication, as may be seen by writing down his working as follows:—

```
     36585
    53658
   85365
  58536
 65853
─────────────
 726,175,665
```

It also seems to have a relation to the well-known fact that any number whose digits, when added together, make a multiple of 9 is itself divisible by 9; for the multiplicand and product in each example are multiples of 9. Perhaps "A. B." *first* invented his rule, then applied it to a number of multiples of 9, picked out those cases in which the product was also a multiple of 9; divided the products by the multiplicands, and thus obtained multipliers from which he selected those which had no fractions. Thus he might have taken 18, multiplied it according to his rule, getting 828, and dividing this by 18; thus arriving at 46 for the multiplier. But 27, 36, &c., yield multipliers with fractions.

Dulwich, *Nov.* 5, 1883. Chas. E. Bell.

LETTERS RECEIVED AND SHORT ANSWERS.

Henry Clark, Subscriber. (Truly as you say what *was* the gun made of.)—T. S. B., H. B. H. Path straightest when moon *new*, most curved when she is *full*.—R. Hill. Have read your lines with much pleasure and sympathy.—H. Moulton, C. L. Tweedale. Far too complex for treatment here.—Alex. Zeitgor A. To what fighting would you invite readers?—Cr. Taylor. Thanks. Author unknown to me. Will forward.—C. Smith. We do not send reporters to lectures.—Justitia Fiat. Many thanks; but *why* should

I look up Mr. Ruskin's remarks about me? You tell me they are wanting in grace and courtesy. Has either quality been shown in anything Mr. Ruskin (or rather he who was Ruskin) has published for the last five years? Were the remarks now by my elbow I should hardly deem it worth while to turn to them. Do we not know the tone? He now groans constantly about some one. Tyndall and Darwin, Spencer and Carlyle, have had their turn: no one but Mr. Whistler ever took any notice. Why should I?—J. W. S. Please send.—E. Wells. Have tried to do as much in my little work (published by the S.P.C.K.)—H. H. Many thanks.—A. M. Mitchison. Shortly: see "Gossip."—J. C. Bryant. That writer is a "her," not a "him." Your letter reserved for publication.

Our Chess Column.

By Mephisto.

THE BOOK OF THE TOURNAMENT.

Third Notice.

Arranged according to openings, the 242 games of the Major Tournament rank as follows:—

Irregular	63	Three Knights	1
Ruy Lopez	51	Steinitz Gambit	4
French	50	Scotch Gambit	4
Giuoco Piano	18	Evans Gambit	4
Sicilian	17	Miscellaneous	20
Four Knights	7		

The term "irregular opening" is somewhat too vague. By far the largest proportion of these games were Queen's side openings, that is, where the ultimate development of the opening proceeds on the Queen's side, although the first moves may vary, as, for example:—1. Kt to KB3, as frequently played by Zukertort; or 1. P to QB4, called the English opening; or 1. P to K3, practised by Mason; or 1. P to Q4, leading to the Queen's gambit, and favoured by Steinitz. Most of these openings led to similar and well-known positions. A few games were opened with 1. P to KB4, mostly by Bird, while but very few games were irregularly opened, in the real sense of the word.

Over 200 of these games were began with *safe* openings. The gambit was adopted in only about twenty cases. The Ruy Lopez deservedly heads the list of regular openings.

Zukertort's games—annotated by himself—furnish an interesting study of this opening. Game 14, between Winawer and Zukertort, brings matters to a crisis in a main variation of this opening, as the game will show:—1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to Kt5, Kt to B3. 4. Castles, Kt takes P. 5. P to Q4, P to QR3 (analysed by Professor Berger, of Gratz, and superior to B to K2, for which move *vide* Game 13, between Zukertort and Winawer). 6. B takes Kt (6. B to Q3, instead, would be met by P to Q4. 7. P to B4, B to KKt5, &c.) QP takes B. 7. Q to K2, B to KB4. Winawer here continued with 8. P to KKt4, which, however, did not lead to any superiority of position. Zukertort here gives 8. P takes P, remarking that this would about equalise the game, in which case, of course, the attack of the first move has failed. This failure confines the attack within narrower limits, *i.e.*, 1. P to K4, P to K4. 2. KKt to B3, QKt to B3. 3. B to Kt5, Kt to B3. To avoid the former variation, White can only continue with either 4. Kt to B3, leading into a tame variation of the Four Knight's Game (*vide* Game 4 between Mackenzie and Zukertort), or 4. P to Q3, which is the stronger move, and was played against Zukertort in Game 19 by English, of Vienna, who is acknowledged to be a thorough master of the Ruy Lopez. Now in order to defend the threatened KP, Black has, apparently, only one good move, that is 4. P to Q3 (4. B to B4, adopted by Rosenthal against Steinitz, *vide* Game 57, is not considered good by the latter player). After 4. P to Q3, P to Q3, English continued as follows against Zukertort:—5. Kt to B3, P to KKt3. 6. P to KR3, B to Kt2. 7. B to K3, B to Q2. 8. Q to Q2, P to KR3. 9. Castles, KR, and White has a superior development. Zukertort here suggests for Black 9. P to KKt4, to be followed by Kt to K2 and Kt3, but we think even then White would obtain a good game by 10. P to Q4, &c. Zukertort must have been of the same opinion, for he never again faced this variation, but became a convert to the defence of 3. P to QR3 in preference, which he adopted in all his subsequent Ruy Lopez defences, *vide* Game 25, against Steinitz; Game 26, against Winawer; Game 29, against Rosenthal; and Game 39, against Mackenzie.

SOLUTIONS.

Problem, No. 108, by B. G. Laws, p. 340.

Author's Solution.

1. Kt to Kt8	K to Q4, or	1.	K to Kt4
2. Q to KR7	any move	2. Q to QB7	anything
3. Q mates accordingly		3. B to Q3, mate	
1.	P to Q4	1.	P to B6
2. Q to QB7(ch)	K to Q5	2. Q to QKt7	anything
3. Q takes P, mate		3. Q mates accordingly	

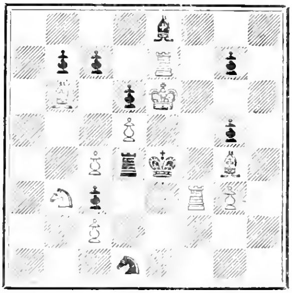
Problem, No. 109, by C. Planck, p. 354.

1. B to Q6	P takes B	1.	K takes Kt (*a*)
2. Kt to B3(ch)	K to B4 (*a*)	2. Q to K5(ch)	K to B6
3. Q to Kt sq, mate		3. Q to K2, mate	
	(*a*) K to K3		(*a*) K to K3
3. B takes P, mate		2. B to QB4(ch)	K to B4
		3. Kt to Kt3, mate	

PROBLEM No. 110.

By Henry Bristow.

Black.



White.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. Canaway.—Castling is not allowed in Tourney Problems, and is not resorted to by most composers.

Berrow, W.—Solutions correct.

Contents of No. 111.

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AN ILLUSTRATED
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PLAINLY WORDED-EXACTLY DESCRIBED

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Contents of No. 113.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

Authors usually lay all blame for mistakes to the printers, but I will be more generous, and confess I may have overlooked, in correcting the proof, that in the second paragraph, p. 316, Nemoptera appears instead of Neuroptera.

There is a common notion that insects are enormously strong for their size, which is true, without the fact necessarily leading to the fancy that if larger creatures had proportional muscular power, they could jump over steeples, and give mountains a shake. The muscular system of insects is, however, very wonderful and well worth examination. If, for example, the thorax of a wasp or bee is opened, the observer will see a number of yellowish bundles. A slight touch will separate them into fibrils, and, under the microscope with a power of about 300 ×, these will be resolvable into *fibrillæ*, very delicately striated across their length.

In the human body, and in invertebrates generally, the striated muscles belong to the voluntary system, and non-striated to most of those organs over which the will has no direct control. Siebold tells us that the muscular fibres of the insecta are striated, not only in the voluntary muscles, but often also in those of organic life, as in the stomach and intestines. Muscular fibres from the thorax of insects do not exhibit the striation nearly so plainly as those from some other parts. For example, such fibres from the thorax of a wasp require a little care in optical management for their striation to be seen at all, while in fibres from the muscles moving the stinging apparatus of a hornet, they are obvious with less magnification. The quantity of muscle in the thorax of a four-winged insect is strikingly large. The work to be done is to give due motion to six legs, besides the wings. The latter organs have to move with considerable rapidity during flight; but the space they traverse in each vibration is small. The wing movements are produced, according to Siebold, by two extensor and several small flexor muscles, which arise from the middle and posterior thoracic segments, and are inserted on a tendinous process at the base of each wing. In insects that use four wings equally in the act of flying, the muscles moving in two pairs are equally developed; but those of the anterior wings of bugs and some other insects whose flight is wholly or chiefly performed by the hind wings, are smaller in size.

The wings of dragon-flies, bees, and house-flies are strong and firm in proportion to their size, which enables them to oppose a considerable resistance to the air. According to an old observation of Leeuwenhoek, a species of dragon-fly outstript a swallow which tried to catch it in a menagerie 200 feet long, but for this rapid flight the muscles are not required to make the wings vibrate any great number of times in a second. According to an article by Mr. J. Bishop, in Tod's "Cyclopaedia of Anatomy and Physiology" an Æschna, causes its wings to vibrate ninety-six times in a second, as a preliminary to flying, when the vibrations become slower, but through larger arcs. The force employed as estimated by the weight moved through a certain space in a given time, does not appear so striking as when only the rapidity of the flight is considered.

If an insect is caught in the fingers its struggles to escape give the notion that its strength is excessive for its dimensions, and experiments to ascertain what weights insects can pull up inclined planes have been held to confirm the opinion. This, however, is controverted by M. Delbeuf, in a paper called "Nains et Géants ("Dwarfs and Giants") which appeared in the *Revue Scientifique*, Jan. 27, 1883. He cites M. F. Plateau's statements, derived from careful experiments, to the effect—"1. That in the matter of flight, insects in relation to their weight possess enormous strength compared with vertebrates; 2. That in the same group of insects the strength of different species varies inversely as their weights, or, in other words, the smallest are the strongest. If, says M. Delbeuf, the strength of a horse weighing 600 kilogrammes, as measured by Regnier's dynamometer, equalled 400 kilogrammes, and if a cockchafer weighing a sixth of a gramme could exert a force of sixty-six times its weight, it would be proportionably one hundred times the stronger, and 40,000 cockchafers would be equal to a large horse. "Must we," he exclaims "resign ourselves to be a hundred times less vigorous than a cockchafer, and two hundred times less strong than a small beetle that lives in dung?" He replies in the negative, and contends that the element of time is omitted in these calculations. "Suppose," he says, "a horse harnessed to a burden equal to half his own weight, and a chafer to another one fifty times its weight, if the horse raised his burden one mètre in a second, and the chafer required one hundred seconds to raise his to the same height, the two efforts would be proportionably the same." After giving many illustrations, M. Delbeuf concludes that all animals are about on a level, and that muscular fibre has the same properties, whether in a vertebrate, articulate, or mollusk.

To return to our insects, it is evident on inspection that their thorax contains a large quantity of muscular fibre in proportion to its capacity. There is no waste of space; the fibre is closely packed, and free from fat or other inert material, and the whole body of an insect is usually very muscular in proportion to its size and weight.

The muscular fibres of insects should be compared with those of other creatures. Any kind of meat well boiled is likely to show them plainly. A very small piece should be taken, teased out with a needle on a slide in a drop of water, and covered with a thin glass, and examined with a ¼ or higher power.

Amongst the aspects presented by striated fibrils under high magnification is one of a series of light squares, containing smaller and darker squares. These must be regarded as optical appearances, not positive exhibitions of structure.

Unstriated muscles are found in man and various animals in the alimentary canal, bladder, ducts of glands, &c. They have been generally considered to consist of elongated cells, but Professor Engelmann states that smooth fibres are really composed of fibrillæ.

They sometimes exhibit striæ, and there is no harsh and absolute distinction between the two sorts. The characteristic "vital property of muscular fibre," says Owen, "is to alter under stimulus its relative dimensions of length and breadth. When it becomes shorter and thicker, it is said to contract, and by these contractions the movements of the body and of its parts are produced."

THE UNIVERSE OF SUNS.

By R. A. Proctor.

(Continued from p. 370.)

In far better accordance with modern ideas, are the views of the great astronomer Christian Huyghens, as expressed in his fine work the "Cosmotheoros.* He held that the sun is one of the stars and resembles them in size and structure. The distribution of the stars he regarded as in a general sense uniform, for he held that the same distance which separates the sun from the nearest star separates that star from the next beyond, that from the next, and so on to infinity. We have already seen that his hypothetical study of the universe led to researches and results of considerable importance.

We owe, however, to Thomas Wright, of Durham, the first attempt to form a complete theory of the universe. The Milky Way was not referred to at all in the speculations of Huyghens, nor was the important position of the star-cloudlets in theories of the Cosmos recognised in Huyghens' time. Wright's views ranged over the whole of the sidereal universe as known in his day; and we shall see that by a bold effort of genius he anticipated the speculations which the greatest of all astronomers based a few years later on observation.

Wright examined the structure of the Milky Way with a reflecting telescope only one foot in length, satisfying himself that the galaxy really consists of a multitude of minute stars. Reasoning concerning the Milky Way, he remarked that if we judge of it only by phenomena we must regard it as a zone of stars surrounding the heavens. But this conception of the Milky Way as a perfect ring is not in agreement with the irregular distribution of the stars which do not lie upon the galaxy, but seem dispersed promiscuously throughout the space surrounding us on all sides. It seems inconsistent with the harmony observed in "all the other arrangements of nature" that one scheme of stars should be arranged with perfect symmetry, while another is scattered irregularly. It is far more reasonable to conclude—so Wright reasoned—that the seeming incongruity is due only to the imperfect nature of our survey both as respects the extent of space and duration in time. "When we reflect,"† says Wright, "upon the various configurations of the planets and the changes which they perpetually undergo, we may be assured that nothing but a like eccentric position of the stars could occasion such confusion among bodies otherwise so regular: in like manner we may conclude that as the planetary system, if viewed from the sun, would appear perfectly symmetrical, so there may be some place in the universe where the arrangement and motions of the stars may appear most beautiful. If we suppose the sun to be plunged in a vast stratum of stars of inconsiderable thickness compared with its dimensions in other respects, it is not difficult to see that the actual appearance of the heavens may be reunited with a harmonious arrangement of the constituent bodies of such a system with respect to some common centre, provided it be admitted at the same time that the stars have all a proper motion. In such a system it is manifest that the distribution of the stars would appear more irregular the farther the place of the spectator was removed from the centre of the stratum towards either of the sides. It is also evident that the stars would appear to be distributed in least abundance in the opposite directions of the thickness of the stratum, the visual line being shortest in these directions; and that the number of visible stars would increase as the stratum was viewed through a greater depth, until at length, from the continual crowding of the stars behind each other, it would ultimately assume the appearance of a zone of light."

It will be observed that in these words we have a complete enunciation of what has been called the Grindstone Theory of the stellar system. The theory is based by Wright on observed facts precisely as it was afterwards based by Sir W. Herschel on other observed facts. Whatever credit appertains to the invention of the theory should in justice be ascribed to Wright, who thus, in 1750, reasoned out and clearly described the views to which Herschel was led in 1784. Wright did not convince his contemporaries, but their slowness of apprehension seems to afford no just ground for depriving him of the credit due to his sound analysis of known facts.

Wright further held that the Milky Way is only one of many systems of stars; though the other systems forming with our galaxy a system of star-systems, may not resemble the galaxy or each other in structure. There may be differences as striking as those which exist between the rings of Saturn and the belts of Jupiter. "Some systems of stars may move in perfect spheres, at different inclinations and in different directions; others again may revolve like the primary planets in a general level; or more probably in the manner of Saturn's ring; nay perhaps, ring within ring, to a third or fourth order."

Wright believed that the common centre around which the stars of the galaxy travel is an orb larger and more massive than the rest. He also considered that there are sidereal systems within the boundaries of the visible universe, and subordinate to the great system of the Milky Way. It is to such parts of the Milky Way that he refers when he speaks of "the immensity of space being occupied by an endless succession of systems, analogous in their structure to the great system" (the Milky Way) "of which the visible universe is composed (and of which they form part)." This seems clear from the way in which he reasons respecting other Milky Ways. For, referring to the theory that such systems exist, he remarks:—"That this in all probability may be the case is in some degree made evident by the many cloudy spots, just perceivable by us, as far without our starry regions, in which, although visibly luminous spaces, no one star or particular constituent body can possibly be distinguished *these, in all likelihood, may be external creations, bordering upon the known one, too remote for even our telescopes to reach.*"

(*To be continued.*)

* It is perhaps not very generally known that the Plumian Professorship of Astronomy at Cambridge was founded by Dr. Plumer as an expression of the pleasure he had derived from the perusal of Huyghens' Cosmotheoros. The work was recommended to him by Flamsteed, the first Astronomer Royal.

† I quote from an abstract of Wright's views in Grant's fine "History of Physical Astronomy."

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXV.

MY first acquaintance with the rational cookery of cheese was in the autumn of 1842, when I dined with the monks of St. Bernard. Being the only guest, I was the first to be supplied with soup, and then came a dish of grated cheese. Being young and bashful, I was ashamed to display my ignorance by asking what I was to do with the cheese, but made a bold dash, nevertheless, and sprinkled some of it into my soup. I then learned that my guess was quite correct; the Prior and the monks did the same.

On walking on to Italy I learned that there such use of cheese is universal. Minestra without Parmesan would there be regarded as we in England should regard muffins and crumpets without butter. During the forty years that have elapsed since my first sojourn in Italy my sympathies are continually lacerated when I contemplate the melancholy spectacle of human beings eating thin soup without any grated cheese.

Not only in soups, but in many other dishes, it is similarly used. As an example, I may name "Risotto à la Milanese," a delicious, wholesome, and economical dish—a sort of stew composed of rice and the giblets of fowls, usually charged about twopence to threepence per portion at Italian restaurants. This is always served with grated Parmesan. The same with the many varieties of paste, of which maccaroni and vermicelli are the best known in this country.

In all these the cheese is sprinkled over, and then stirred into the soup, &c., while it is hot. The cheese being finely divided is fused at once, and being fused in liquid, is thus delicately cooked. This is quite different from the "maccaroni cheese" commonly prepared in England by depositing maccaroni in a pie-dish, and then covering it with a stratum of grated cheese, and placing this in an oven or before a fire until the cheese is desiccated, browned, and converted into a horny, caseous form of carbon that would induce chronic dyspepsia in the stomach of a wild boar if he fed upon it for a week.

In all preparations of Italian pastes, risottos, purées, &c., the cheese is intimately mixed throughout, and softened and diffused thereby in the manner above described.

The Italians themselves imagine that only their own Parmesan cheese is fit for this purpose, and have infected many Englishmen with the same idea. Thus it happens that fancy prices are paid in this country for that particular cheese, which is of the same class as the cheese known in our Midland Counties as "skim dick," and sold there at about fourpence per pound, or given by the farmers to their labourers. It is cheese "that has sent its butter to market," being made from the skim-milk which remains in the dairy after the pigs have been fully supplied.

I have used this kind of cheese as a substitute for Parmesan, and I find it quite satisfactory, though it has not exactly the same fine flavour as the best qualities of Parmesan, but is equal to that commonly used by the Italian millions. The only fault of our ordinary whole-milk English and American cheeses is that they are too rich, and cannot be so finely grated on account of their more unctuous structure, due to the cream they contain.

I note that in the recipes of high-class cookery-books, where Parmesan is prescribed, cream is commonly added. Sensible English cooks, who use Cheshire, Cheddar, or good American cheese, are practically including the Parmesan and the cream in natural combination. By allowing these cheeses to dry, or by setting aside the outer part of the cheese for the purpose, the difficulty of grating is overcome.

I have now to communicate another result of my cheese-cooking researches, viz., a new dish—*cheese porridge*—or, I may say, a new class of dishes—cheese-porridges. They are not intended for epicures, not for swine who only live to eat, but for men and women who eat in order to live and work. These combinations of cheese are more especially fitted for those whose work is muscular, and who work in the open air. Sedentary brain-workers like myself should use them carefully, less they suffer from over-nutrition, which is but a few degrees worse than partial starvation.

Typical cheese-porridge is ordinary oatmeal porridge made in the usual manner, but to which grated cheese is added, either while in the cookery-pot or after it is taken out, and yet as hot as possible. It should be sprinkled gradually and well stirred in.

Another kind of cheese-porridge or cheese-pudding is made by adding cheese to *baked* potatoes—the potatoes to be taken out of their skins and well mashed while the grated cheese is sprinkled and intermingled. A little milk may or may not be added, according to taste and convenience. This is better suited for those whose occupations are sedentary, potatoes being less nutritious and more easily digested than oatmeal. They are chiefly composed of starch, which is a heat-giver or fattener, while the cheese is highly nitrogenous, and supplies the elements in which the potato is deficient, the two together forming a fair approach to the theoretically-demanded balance of constituents.

I say *baked* potatoes rather than boiled, and perhaps should explain my reasons, though in doing so I anticipate what I intended to say when on the subject of vegetable food.

Raw potatoes contain potash salts which are easily soluble in water. I find that when the potato is boiled some of the potash comes out into the water, and thus the vegetable is robbed of a very valuable constituent. The baked potato contains all its original saline constituents which, as I have already stated, are specially demanded as an addition to cheese food.

Hasty pudding made, as usual, of wheat flour, may be converted from an insipid to a savoury and highly nutritious porridge by the addition of cheese in like manner.

The same with boiled rice, whether whole or ground, also sago, tapioca, and other forms of edible starch. Supposing whole rice is used, and I think this the best, the cheese may be sprinkled among the grains of rice and well stirred or mashed up with them. The addition of a little brown gravy to this gives us an Italian risotto.

Pease pudding is not improved by cheese. The chemistry of this will come out when I explain the composition of peas, beans, &c.

I might enumerate other methods of cooking cheese by thus adding it in a finely divided state to other kinds of food, but if I were to express my own convictions on the subject I should stir up prejudice by naming some mixtures which some people would denounce. As an example I may refer to a dish which I invented more than twenty years ago—viz., fish and cheese pudding, made by taking the remains from a dish of boiled cod-fish, haddock, or other *white* fish, mashing it with bread crumbs, grated cheese, and ketchup, then warming in an oven and serving after the usual manner of scalloped fish. Any remains of oyster sauce may be advantageously included.

I find this delicious, but others may not. I frequently add grated cheese to boiled fish as ordinarily served, and have lately made a fish sauce by dissolving grated cheese in milk with the aid of a little bicarbonate of potash. I

suggest these cheese mixtures to others with some misgiving as regards palatability, after learning the revelations of Darwin on the persistence of heredity. It is quite possible that, being a compound of the Swiss Mattieu with the Welsh Williams, cheese on both sides, I may inherit an abnormal fondness for this staple food of the mountaineers.

Be this as it may, so far as the mere palate is concerned, I have full confidence in the chemistry of all my advocacy of cheese and its cookery. Rendered digestible by simple and suitable cookery, and added, with a little potash salt, to farinaceous food of all kinds, it affords exactly what is required to supply a theoretically complete and a most economical dietary, without the aid of any other kind of animal food. The potash salts may be advantageously supplied by a liberal second course of fruit or salad.

MIND IN THE INFANT.

The early and obscure beginnings of mental life as they manifest themselves in infants have always had a great and absorbing interest for mothers. But it is only within the last decade that it has been authoritatively recognised, that those very facts which are so fraught with interest to mothers are also of paramount importance to men of science.

The marvellous transition from the pathetic helplessness of the new-born babe to the grand capabilities of the adult man is a phenomenon which has always, it is true, called forth the speculations and attracted the attention of scientific inquirers. But these all (with one notable exception) failed to see, that if they hoped for an adequate solution of the problem, they must be prepared to take up their stand by the cradle, and ascertain there, by personal observation and experiment, how mind begins to unfold itself. For, as by no effort of memory can a man remember his own mental development during the first three years of his life, it is clear that the psychologist is inevitably driven upon one of two alternatives. Either he must infer what goes on in the mind of the child from what goes on in the mind of the adult, or he is bound to watch for each gleam of intelligence and sensibility as these reveal themselves to us through the medium of the cries, movements, and facial expression of the babe of a few weeks old. It is precisely this latter more satisfactory method which the psychologists abstained from adopting, and the natural consequence was that many fruitless controversies were waged over unreliable theories set up to explain the processes of mental development. We have said that there was one exception to the prevailing indifference shown to the phenomena of infant life; this was the German philosopher, Thiery Tiedemann, who at the close of last century held a professorial chair at the University of Marburg.

Exactly one hundred years ago Tiedemann published a series of carefully-recorded observations, arranged in journal fashion, and extending over the first two years of his child's existence. By means of this memoir he sought to promote the experimental study of the human mind, more especially as it displays itself at the commencement of life. His example, however, apparently stimulated no one to the prosecution of similar investigations, and, indeed, it is only through a translation of Monsieur Michelant's, published eighty-one years later in the *Journal de l'Instruction Publique*, that this remarkable record is at length brought within the ken of the ordinary reader.

Now, after the lapse of many years, there has been a sudden rush of psychologists into the hitherto neglected field, and this particular department of infant psychology has been enriched by contribution after contribution of varying value, but of constant interest, from the pens of Darwin, Taine, Egger, Preyer, Sully, Ferri, Pollock, Perez, &c.

But numerous as are the facts chronicled by practised observers, such as are the foregoing, there yet remains wide scope for the exercise of parental activity in collecting still further data, and so assisting to constitute what has been aptly designated an Infant or a Nursery Psychology.

We cannot, therefore, too emphatically impress upon parents—more especially upon mothers—the wisdom of keeping an accurate register of all the varied phenomena they note in their offspring; and, in order that they may do this to really good and practical purpose, we propose, in a series of articles, laying before them all that is at present known with regard to this singularly interesting subject, and inviting them to inform us how far the facts they themselves observe corroborate or conflict with the conclusions which have been come to.

Still more to guide them in their work of observation, we shall subjoin tables showing the acquisitions of different infants during each month of their first year and each quarter of their second and third years. We shall also suggest simple experiments which may be tried upon infants when the elucidation of debatable points is in question.

And lest mothers should imagine that they are being invited to take up this work of minute and detailed observation merely in the interests of a science which they may or may not care to advance, we would refer them to an admirable article in *La Revue Scientifique*.

The writer, Monsieur Compayré, here points out forcibly how great is the assistance which a knowledge of the mental phenomena of infant life is calculated to give the educator. Education, he says, being nothing but art intervening to direct and control natural tendencies; it is impossible to make much way if the educator does not know the needs of children in order to satisfy them, their capabilities so as to call them forth, and their powers so as not to put too severe a strain upon them. In short, he says the artificial methods of education can only succeed when they are modelled upon the first steps of Nature herself—that is to say, upon those natural processes which we can see going on in the early life of the infant.

He then cites as an instance of the sort of knowledge needed by those who have the care of children, the well-known psychological fact, that a quite little child cannot fix its attention for more than five or six minutes at a time, while even with children of more advanced growth, half an hour of concentrated attention is the utmost they are capable of yielding without short intervals of rest and recreation. How often does a mother punish her child for its obstinacy in not attending, when, really, the blame should fall upon her for her folly in not acquainting herself with the laws of its nature. How often, again, does she not attempt to develop some faculty, without knowing that she is, all unwittingly, helping to impede its exercise.

In the interests then of the infant, even more than in those of the psychological philosopher, it is time that the different facts of infant mental life should be carefully systematised and placed within the reach of the mothers of England. And this is what, in a series of some dozen articles, we shall now attempt to do.

A. M. H. B.

TRICYCLES IN 1883.

By John Browning,
Chairman of the London Tricycle Club.

THE ROVER—THE NEW RUCKER—THE COBWEB—THE COVENTRY TANDEM—AND THE OARSMAN.

SOME months since an article of mine appeared in Knowledge, "On the Form of the Tricycle." In this article I referred to the various good points of rear-steering machines. The article was, I regret to say, greatly misunderstood. Many of my readers jumped at the conclusion that I recommended rear-steering machines in preference to front-steerers. This was far from my meaning. What I strove to show was this:—That the faults of rear-steerers were not due to their being rear-steerers, but were due to details of construction. These faults were mainly two. They were only single drivers, and the action was not sufficiently vertical—that is, the rider sat too far behind the pedals and thrust at them, instead of sitting more directly over them and using his weight upon them.

I argued that, if these faults were corrected, the rear-steering machine might, from the facility with which it can be mounted and dismounted, from its smaller weight and its more graceful appearance, regain the ground it had lost, and again come into public favour.

About a fortnight ago, Mr. Leni, of West Kensington, drew my attention to a new rear-steering tricycle, the "Rover," made by Starley & Sutton.

My tricycling readers will understand, I believe, what this tricycle is like when I tell them that it is a "Meteor," in which the pedals are well behind the axle, which runs right across the machine, and that the rider's saddle is supported on an Arab spring placed on the backbone, and that the machine is a double-driver by a balance gear.

The machine combines the advantages of a hind-steerer with those of a front-steerer, and has some of the best points of the "Humber." It can be mounted and dismounted easily from behind, while it is just as easy to dismount from the front should it be desirable to do so.

The axle runs through a hollow casing, which does not turn round.

When running down hill, the feet are placed on this axle as a foot-rest; in the event of an accident, the hind-wheel would tip-up, and the rider come down on his feet, instead of falling mixed up with the machine, as he would were he riding a front-steerer.

The makers are prepared to supply the "Rover" with driving-wheels as small as 42 in. These should be geared-up to from 46 in. to 56 in., according to the strength of the intending rider.

If the machine could be supplied with a two-speed gear working down to 35 in. for hill-riding, and up to 55 in. for good level roads, or slight downward inclines, it would be one of the best and fastest machines of the day. It appears to be well made and finished, and lightness has been fairly studied in its construction. I have driven it as fast as I can ride over a good road, and also over the worst road I could find—some inches of mud and new stones—and it behaved well on both. Experience will, I do not doubt, prove that this machine can with practice be ridden down hill as fast as any front-steerer. If so, the hind-steering machines must again be considered as equal to the front-steerers, and further improvements may be looked for in their construction.

I shall expect to hear of some good work being done on the "Rover" next season. I should like to point out that this is another case of a good and well-planned machine in which a considerable amount of the weight of the rider is thrown on to the small steering-wheel, though the opponents of small wheels declare that the necessity of doing this in machines made with them is an insuperable obstacle to their adoption.

To Starley & Sutton belongs the credit of having introduced the "Meteor"—the first hind-steerer which achieved a great popularity. The credit is now due to them of bringing out the improved hind-steerer, the "Rover," as an advance upon any front-steering machine made.

Mr. Rucker has kindly shown me a new front-steerer he has just designed, which has some important advantages over any other front-steering machine.

Unlike most front-steerers, this machine can be mounted and dismounted with equal facility, either from the back or front. It is a vertical-geared double driver, with bicycle pedals, adjustible in length of throw to suit the rider, and will shortly be supplied with a two-speed gearing when ordered. It is exceedingly light, and the workmanship is admirable. Mr. Rucker has been so good as to undertake a commission for me for one of these machines, with a two-speed gearing, and the wheels to be only 38 in. diameter, to my own specification. I expect to find this a very fast, safe, and convenient mount, and I will report on its performance as soon as I have done some work on it. I am decidedly of opinion that it is the best front-steering machine I have yet seen.

The new "Rucker" can in a few minutes, by only reversing the position of the driving-wheels to the opposite sides, be converted into a hind-steerer, when it possesses many of the advantages of the "Humber."

In the course of these articles I have frequently referred to the excessive weight of tricycles.

The first "Sociable" tricycle I had weighed 186 lb.; this was a first-class manufacturer's ordinary make. The second weighed 150 lb., the third 133 lb.; both these machines were made to my own specifications. I have just had completed for me a new "Sociable," which one of my cycling friends has christened the "Cobweb." This weighs only $80\frac{3}{4}$ lb., and I believe it possesses surplus strength for the work required of it.

Mr. Hirst, of Croydon, in carrying out my designs for this machine, has shown himself an artist in tricycles. Every separate piece has been fashioned into the most shapely form, with a minimum of weight and maximum of strength. All the handle-rods, seat-rods, and brake-rods, as well as the whole of the frame, are of weldless steel tube. The wheels, which are 36-in. diameter, have hollow rims and laced spokes. The suspension saddles have skeleton frames. Every piece of the work, besides those mentioned, is forged out of the finest Bessemer mild steel, which will bend, but will not break. It is, perhaps, desirable to say that such work cannot possibly be supplied at the price charged for machines in which many of the parts are of malleable iron castings. On this machine I am able to drive a heavy man, not working, over a rough road.

I have just seen and tried a new single front-steering tricycle invented by the Rev. J. M. Taylor, of Seer Green Vicarage, near Beaconsfield. This machine is known as the "Oarsman." It has a sliding-seat, and the action is that of a rower sculling, though there are no oars to the machine, but two handles that run parallel with the sides. The rider can exert enormous force by reaching down nearly to his feet, and then pulling up in a straight line, bringing himself to his full length in an inclined position.

The roads were in a shocking condition when I tried the "Oarsman," but I can readily believe that, when the conditions are favourable, great progress can be made with this machine. The driving wheels run with a new clutch,

and from 10 to 20 yards can be covered with a single pull of the handles.

The new Coventry Rotary Tandem is a "Sociable," made on the same lines as the single machine, but with a second seat and pair of pedals and chain wheel, all of which can be removed in a few minutes so as to convert the machine into a single when required. It is very light for a Sociable, the weight being about 95 lb. It is an exceedingly fast machine, but would require rather careful riding, and is more suitable for two gentleman than for a lady and gentleman. Still a lady could ride on the front seat, and, as there are two steering-handles, a gentleman riding behind could steer.

ASTRONOMICAL COLLISIONS.*

By Prof. C. A. Young, Princeton, N.J.

THE universe of space is, in one sense, full and crowded. Everywhere our telescopes find stars; and for every one we see there are probably hundreds, and even thousands, too faint or small or far away to reach our senses. And of this countless host of worlds not one is at rest, but all are rushing through space, free and unbridled, with velocities far exceeding anything in the range of our terrestrial experience. Our swiftest cannon-shot takes more than three seconds to go a mile, but the stars and planets seldom move slower than five miles a second, and some of them go two hundred. The veriest snail among them would overhaul a rifle-ball in the same sort of way that the rifle-ball would overtake a receding freight-train. Is there not, then, danger of collisions? Have such collisions ever occurred; and, if so, with what consequences?

Now, in the first place, it is only in a sense, and rather a Pickwickian one, that space can be called crowded. True, stars are to be seen in every direction; but this is because our vision reaches so unimaginably far. If we restrict our consideration to bodies of respectable magnitude,—a hundred miles in diameter, for instance,—we ought rather to say that space, instead of being crowded, is almost inconceivably empty. Between any star or planet and its nearest neighbour, lie usually desolate distances of millions, or even millions of millions, of miles. If we assume, what is probably an under-estimate, that the region commanded by our telescopes is so vast that light takes a thousand years in coming to us from its outer confines, and, further, that the number of its stars is a thousand millions (the number visible with our largest telescopes is usually estimated at about sixty millions), then we find that the average distance from star to star must be about nine millions of millions of miles. This is not quite half the actual distance from the sun to our nearest stellar neighbour (α Centauri), according to the received value of its parallax; but it is a distance which quite defies the power of human comprehension. If two stars at such a distance were rushing straight toward each other with a speed of ten miles a second, it would require nearly 30,000 years to bring them together. Represent the sun, as in Sir John Herschel's familiar illustration, by a globe 2 ft. in diameter, so that oranges, cherries, peas, and pins'-heads would stand for the different planets at distances ranging from 80 ft. to two miles, then, on that scale, α Centauri would be 8,000 miles away. Obviously, there is plenty of elbow-room in the universe, and the chance of two stars accidentally jostling each other is far less than that of the collision of two bullets in mid-air over a battle-field. Still the possibility remains.

There is a prevalent impression that the immunity from collision between the heavenly bodies depends mainly on their being held in orderly orbits by central attraction; and it is true that their orbital constraints make it quite impossible for the *planets* to collide with each other, or even to approach each other very closely. But a very impressive picture is sometimes drawn of what would happen if the earth, for instance, should some time free herself from the bonds of gravitation—how she would fly off into space (which is true, of course), and soon dash herself to pieces against some other wandering world (which is not true at all, or at least not probable). Most likely, if gravitation were suddenly to cease, the earth would travel for millions, not of years, but of ages, without ever encountering anything more important than meteors such as are now continually falling upon her surface. And these meteoric encounters, even, would probably be far less frequent than at present, since there is reason to suppose that such bodies are much more numerous in the neighbourhood of the sun, and of other great stars, than in the rest of space.

Evidently, however, the attractions between a wandering star and others lying near its path must considerably increase the chances of collision, though not to so great an extent as perhaps might be supposed. A body entering our system at a distance from the sun one hundred times as great as the radius of the earth's orbit, and moving with no more than the velocity natural to a comet at that distance (about $2\frac{3}{4}$ miles per second), would not strike the sun unless its path were directed within less than half a degree (23.′4) of the sun's centre; and if its velocity were greater, the aim would have to be still more accurate to score a hit. If bodies were shot into space at random from the position and with the velocity indicated, only about one in eighty-six thousand would hit the sun. Were it not for the sun's attraction, however, the proportion would be twenty thousand times smaller still—only one in seventeen hundred millions.

It is obvious, therefore, that encounters between heavenly bodies of considerable magnitude must be extremely rare. There is not in all the astronomical record a single certain instance of such an occurrence. And yet it may confidently be asserted that some time or other in the past such events must have happened, and some time in the future will happen again; simply for the reason that, in a sufficient length of time, the most improbable things, if only not impossible, are sure to come to pass. Now, it is almost certain that the stellar motions are not such as to render collisions impossible: the planets, it is true, as has been said before, can never run into each other, because of the size and nature of their orbits, but, so far as can now be ascertained, nothing of the sort holds good for the motion of the stars. We already know enough about some of their so-called "proper motions" to be quite sure that, as a fact, they are not travelling in any simple curves around any common centre, and also that some stars are flying through space with such velocities that no attraction, such as can reasonably be supposed to act in the premises, can control them. Nor does theory, any more than observation, indicate a structure of the stellar universe at all analogous to that of the planetary system. Among the stars there is no central dominance and no imperial power, but we have to do with a republic of comparatively free and independent members.

Sir William Thomson is therefore fully justified in writing: "It is as sure that collisions must occur between great masses moving through space as it is that ships, steered without intelligence to prevent collision, could not cross and recross the Atlantic for thousands of years with immunity from collision." Undoubtedly, the chance of an

* From the *North American Review*.

encounter between a pair of heavenly bodies, selected at random, is trifling, almost beyond the power of computation, and the intervals of time between such catastrophes, in that part of the heavens subject to human observation, must be, on the average, enormous; but yet, in infinite time and unbounded space—somewhere or other now, sometime or other here—such things are happening, or will come to pass.

To be continued.

RECREATION BY WONDER.*

NEXT to uncertainties as parts of recreation, I named wonders, meaning to include the objects of all forms and degrees of wonder, from quiet admiration to utter astonishment or awe. Of course, the issue of a chance or of a game of skill may excite wonder, and its use for recreation may be thus enhanced; but we may think of the recreation due to wonders as something distinct. Their fitness for recreation is as evident as that of uncertainties, and similar. Whatever most men's daily work may be, or wherever they may pursue it, they become so accustomed to it, so familiar with all around them, that they may cease to wonder at anything within their range. They may have their work in the midst of glorious scenery, among mountains, or by the sea, or in their own rooms among marvellous beauties of art, but they observe little or nothing of all this; or they may be working at any of the applications of the wonderful discoveries of recent times, but they have long ago ceased to be astonished at them. Some of us may, indeed, upon reflection or in calm thinking, be moved by the wonders among which we have been living: they are very happy times when we can so meditate; but usually and habitually we are seldom conscious of any stirring wonders in our customary work. The finding and observing of them elsewhere is, therefore, a real recreation, and a chief part of a very large number of the mental refreshments which we most earnestly seek and most thoroughly enjoy. And happily it is so; for the contemplation of wonders may give occupation, and thereby strength, to one of the noblest parts of our minds—the part which not only, as Aristotle pointed out, first leads to studious research, but that which is exercised in the highest admiration and reverence, and which acts, together with the imagination in the forming of the highest ideals towards which we can ever strive.

It is easy to find instances in which the greatest charm of recreation is in the wonder to which they move us. I watched one in myself some weeks ago when I went over the electric-lighthouse on the Lizard Point, enjoying and feeling refreshed by all the wonders that I saw there: the wonders of the burners that would give the light of many thousand candles; and of the multiplied reflectors and lenses by which, of all this light, none might be wasted, but all sent right out to shine for miles over the sea; the admirable cleverness and precaution by which, if the electric light were, by any accident, hindered, a huge paraffin lamp, with its concentric wicks, would instantly take its place; and then the wonders of the fog-horn, with its great reservoir of air so condensed by steam pressure that, being let go, it would blow a blast upon the horn which should be heard out at sea miles beyond the distance at which, in the dense fog, the light could be seen.

I wondered at all this and was refreshed; and I wonder still as often as I think of it, and thus constantly renew my recreation. And I think, too, of the contrast between myself and the keeper of the lighthouse who showed it to me. He was an admirably intelligent workman, complete in his knowledge of the machinery; as complete in his knowledge as I was in my ignorance; proud, too, of the work in which he was engaged, and happy, I think, in its utility. But to him it was no wonder; he showed it with all the quietude of routine, and spoke rather wearily of the hours spent in watching it. To him there was no recreation in it all; it was the object of his daily work.

The same charm of wonder and the same kind of contrast may be found in a thousand other instances. We enjoy the surprises of conjuring tricks, which to the conjuror himself, I suppose, give no stirring pleasure; and of fireworks, and the stories and actings of perilous adventures. More worthily, we may enjoy and be refreshed by the marvels of skill in art, in music, or in singing. When we listen to a long-sustained high note—such as Albani can sing or Joachim can play—we are refreshed not only by the beauty of the sound, but by the wonder that it can be produced; and it is this which most refreshes us when, long afterwards, we can recall the sound. It is after the same manner that we are refreshed by glorious scenery, the grandeur of mountains, of cataracts, of floods of light at sunset: they move us to wonder, and we enjoy them and they refresh our minds, though those who live among them may be unmoved. And so it is when we leave home and find recreation in the strange sights and customs of other cities; and foreigners come here and are as happy in their wonder at the things which we are tired of looking at. What would not one give to be able to come to London as a stranger and be surprised at the sights that, unless in careful thinking, we now care nothing for?

* From an article by Sir James Paget in the *Nineteenth Century*.

A Cat upon a Roman Tile.—At Dowgate-hill the roadway known to the Romans was 14 ft. or 15 ft. beneath the present pavement. To that extent Roman London is beneath us, just as old Rome underlies the modern City, ancient Jerusalem the modern Holy Places, and the Troy of Homer the existing Hizarlik. One very striking remnant of the conquerors was found in this classic spot. It was a Roman tile, 13 in. square and 1½ in. thick, and had formed, according to the usual practice of those expert and substantial builders, part of a layer of a rubble wall. But that which made it strikingly interesting was the impression of a cat's foot distinctly marked in one corner. It was a fossil imprint of the most perfect character. *Pussy had left the stamp of her paw on the soft clay.* The British or Roman brick-maker, without heeding it, had baked his brick carefully and well, and there, after fifteen centuries, was the impression as distinct as if it had been struck on a coin but yesterday. It was a type of what the geologist is familiar with. Mr. Charlesworth found the impress of a butterfly in strata that had been buried more than as many thousands of years: Lyell has recorded footprints of birds and reptiles in rocks that must have been many ages old, ripple marks on the sandstones of seas in vastly remote epochs; while in the Laurentian rocks of Canada Dr. Dawson has traced marks of lowly forms of life that must have been embedded or imprinted millions of years ago. So might it have been with pussy's footprint. She and her mistress—perchance a Roman lady of high degree, possibly with a residence hard by in Watling-street—and everything that pertained to the Roman occupation might have been things millions of years gone by, and yet that footprint has remained as fresh as it is to-day.—*Daily Telegraph.*

THE BÜRGIN DYNAMO-ELECTRIC MACHINE.

ONE of the most interesting, most efficient, and withal most mechanically perfect machines ever produced is the one which we owe to the ingenuity of M. Bürgin, of Bâle, supplemented by the talented improvements of Mr. Crompton, of Chelmsford, and which is represented by Figs. 1 and 2, Fig. 1 showing the commutator and Fig. 2 the driving pulley. Fortunately for most parties, if not for all, M. Bürgin's invention has not been made the subject of any great amount of speculation. It is therefore free from the troubles and difficulties which beset many another machine from such a cause, and it is in consequence placed on the market at a price which renders the adoption of the electric light more than usually practicable.

To find the parent idea apparent in the construction of

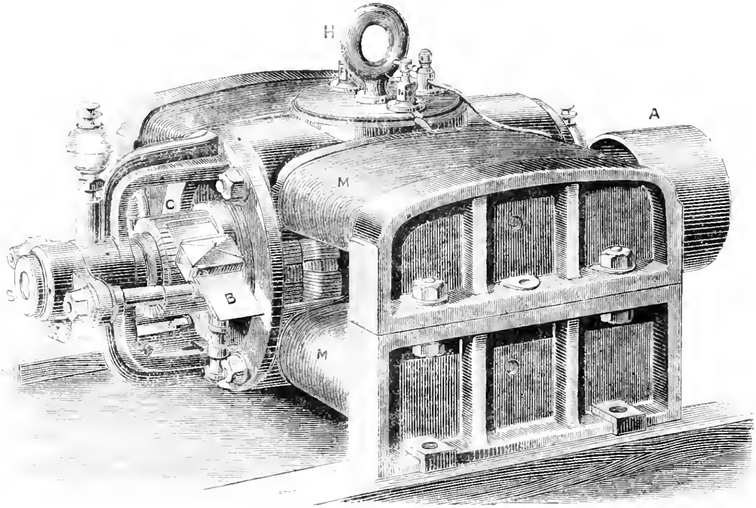


Fig. 1

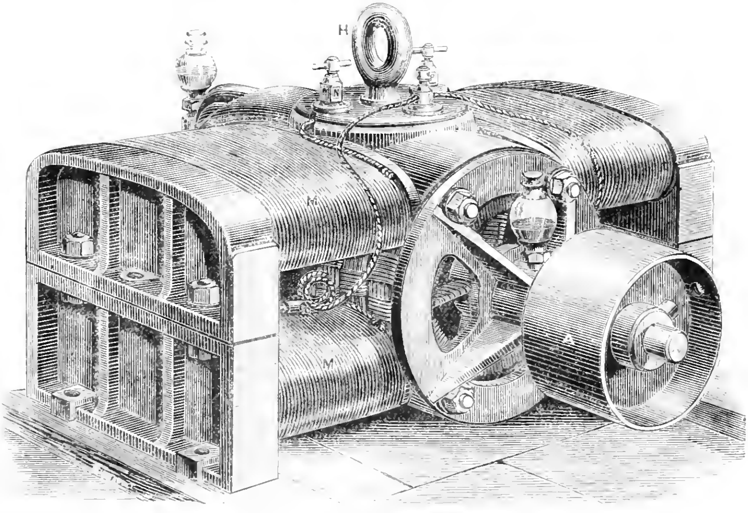


Fig. 2.

the machine, we must go to the Gramme, upon which, however, the Burgin is in many critical points a decided improvement. Our readers are doubtless aware that in the Gramme machine the armature, or that part in which the current is generally speaking said to be generated, consists

of a coil or ring of iron wire over which a series of coils of copper wire are wound. These coils are continuous, that is to say they are side by side, and so form a compact ring in which the iron core is entirely covered. This ring in

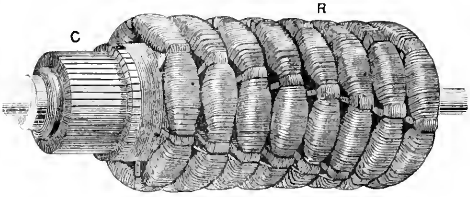


Fig. 3.

being fixed has to be forced on to a wooden spindle, so that in revolving the rotation of the ring is dependent upon the friction between the cotton-covered wire and the wood. As the tendency of the current in the inducing or field magnets is to arrest rotation (otherwise no current could be generated in the ring), it is manifest that to attain high velocities with safety, some device of a higher mechanical order is desirable. This is one of the many advantages pertaining to the Bürgin dynamo. The armature (Fig. 3) consists, not of one but of a number of rings, each ring being composed of a coil of soft iron wire pressed out into a hexagonal shape, so that there are six corners, all of which would be touched by a circumscribing circle. On each straight section of the iron core—or, in other words, on each side of the hexagon—are wound five layers of cotton-covered wire (W, Fig. 4), each layer being shorter than the subjacent one, so as to give, when the six coils are finished, an approximately complete circle externally. A piece of gun-metal (J), star-like in shape, with six spokes or radiations, is then forced very firmly into the ring, each spoke finding its position in one or other of the corners of the hexagon. The gun-metal star has a hole in the centre through which an iron spindle (S) is passed and made rigid. It will thus be seen that the mechanical virtue is exceedingly good and almost perfect. Six, eight, or more such rings are placed on the spindle, and constitute the armature. In the Gramme machine *contiguous* coils are connected together, and in the Brush machine, it may be remembered, the *opposite* coils are connected; but in the Bürgin machine the connection is materially different, very novel, but also very ingenious. The arrangement is to connect, say, the first coil of the first ring to the coil of the second ring which is next behind it, and thence to the next succeeding coil of the third ring, and so on, each ring being one forty-eighth of a revolution behind the one electrically in front of it. (See Fig. 3.) Supposing the armature to have six rings, the sixth coil of the sixth ring is connected to the second coil of the first ring, which is again connected to the third coil of the second ring, and so on till the series is completed. This gives to the armature all the advantage of the Gramme ring, besides which it is worth noting the open nature of the structure, and the absence of non-conducting materials helps very materially to keep the machine cool, a highly-desirable result, which is further assisted by the comparatively very small quantity of copper wire employed. It must not be forgotten that apart from the mechanical objection to heating, an increase of temperature affects adversely the resistance of the wire. The commutator, or that part of the machine where the current is made to pass out of the armature into the field-magnets and the external surface, is similar to the Gramme, the junction of each pair of coils being connected to the same sectional strip of phosphor bronze (a very durable metal which is used for the purpose). Not the least of the advantages embraced in M. Burgin's invention is the great facility with which the armature may be taken to pieces for examination or repairs.

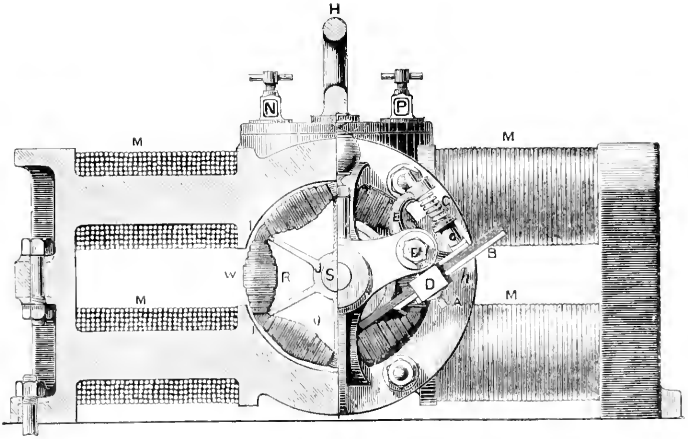


Fig. 4.

The generating or field magnets (M, M) are well depicted in Figs. 1, 2, and 4. The whole of the iron framework and the cores of the magnets are cast in two pieces, one of which is placed above and the other beneath the armature. The cores are of oval section, and the wire is so wound as to make the two crescent-shaped pole-pieces, which almost envelope the armature, of opposite polarity.

Want of space compels us to defer for a fortnight the completion of our remarks on this dynamo.

THE "VIBRATO."*

SOME years ago an exhibition of various manufactured articles was opened in London, one room being set apart for selected specimens of the worst taste, and intended to serve as a warning. In this chamber of horrors a gentleman in the carpet trade espied a design with the name of his own firm pilloried thereon. "Well," said he, "it may be ugly, but they have hit upon the very pattern we sell most of." It must be acknowledged that our vocalists, male and female, native and foreign, with only a few glorious exceptions, have adopted the system of the carpet-maker, and submit to the public, not the best, but the most saleable wares. There exists at present a great demand for the execrable quality of tone called the "Vibrato" or the "Tremolo" (thank Heaven there is no English word for it), and most abundant in consequence is the supply. Now, people are not generally aware that in this intermittent character of tone lies the very essence of dissonance, and this admits of an easy illustration.

Take two tuning-forks in unison, slightly alter the pitch of one of them by loading its prongs with a small pellet of wax, and sound the two together. If the forks are mounted on what are called resonance boxes, the effect is more striking, but it is sufficient to place the handle of each on a wooden board or table. Then are heard what are termed "beats," which imitate to perfection the vibrato of our operatic singers. On further loading the fork, by fixing a small coin, the beats succeed one another more quickly, and, in fact, the greater the interval the more rapid the beats. We may continue the process till we can no longer count them, or even distinguish them as separate strokes of sound. Still the intermittent character, the unpleasant roughness, remains, attaining its maximum when the forks are a semitone apart, and disappearing at about a minor third, which is called the beating distance. Now, every musical note is compounded of a fundamental and several partial tones, the whole constituting what is called a clang, and Helmholtz has shown that a dissonance can arise only when the notes of one clang are within beating distance of the notes of the other. It amounts to this, that consonance is a continuous and dissonance an intermittent sensation of tone, and that the latter is due to alternate augmentation and diminution of sound; in fact, to the same causes which produce the "vibrato."

Is it not, then, monstrous that singers should introduce, and that listeners should be found to tolerate, that which is simply the foundation of discord? If it should happen to be a consequence of failing powers, we must make the best of it, in consideration of other compensating qualities, supposing such to exist. But indulgence may be, and is, carried too far. Thus we often hear what is called a high chest note applauded, not for its quality, which is doubtful, nor for its effect, which is generally misplaced, but as a recompense for the evident and intense effort required to produce it.

There is in all this between the public and the singer a mutual reaction fatal to the interest of art. Dramatic effects, utterly without novelty or refinement, are forced upon the audience by the performer, who himself gives the well-understood signal for applause. What wonder that these tricks of the trade should be resorted to as a substitute for the results of long and conscientious study? On the other hand, people will not pretend to be wiser than their neighbours, and they imagine that such popular and highly-paid artists can do no wrong.

It is time to protest. Singing as an art is undoubtedly on the decline. There is no lack of fine voices, but pure and equal vocalisation is almost a thing of the past. It is not to be expected that many people should trouble themselves with the physical reasons for a disagreeable sound, but it is a great gain that science should come to our aid by confirming and justifying our unfavourable impressions.—Frederick Ricardo.

* From the *Choir*.

AN ANCIENT COMET.

THE Greek writer Apollonius states that the Babylonians regarded comets as wandering stars, and that they were able to predict their appearance. There is little doubt that the Greek astronomers derived much of their early astronomical knowledge from Chaldea, and that many of the curious omens and superstitions connected with the stars, comets, and other celestial phenomena, which survived until the middle ages, had their origin in the astrological works of Chaldea. The great astronomical work, consisting of seventy tablet-books, which formed the standard work of the Babylonians was called "Nännar Beli," the "illumination of Bel," was by the Babylonians said to have been drawn up by Sargon of Akkad, the Romulus of Chaldea, who was the founder of the great Semitic dynasty of North Babylonia. This dynasty might be compared to the Ming dynasty of the Chinese, for it was during, according to tradition, his reign that the great consolidation of Babylonian literature took place, and the various encyclopædic groups of tablet-books were drawn up. The date of this king is now fixed by a passage in a recently-discovered inscription as B.C. 3750, and contemporaneous inscriptions of Sargon and his son have been found at Aboo Hubba by Mr. Rassam. There is in the British Museum a copy, from the library at Nineveh, of a chronicle of his reign, each chapter or paragraph of which begins with a statement as to the omens of the moon at the time the event took place. Several tablets of the great astronomical work have been published in the third volume of the "Cuneiform Inscriptions of Western Asia,"* and some have been translated by Professor Sayce in his valuable paper on Babylonian Astronomy ("Trans. Society Bibl. Arch." Vol. III., pt. ii.). The more complete study of the ancient Akkadian dialects of Babylonia, in which most of them are written, and the great increase in the number of inscriptions enables us now more fully to understand these very difficult texts. The obscurity of the inscriptions of this class is not a modern difficulty, for we frequently find the scribe noting in the text phrases which could not be explained, or slavishly copying the archaic text of the Babylonian version. It is this great work which must now become our standard text-book for the study of the astronomy and astrology of the ancient Babylonians. Turning to it to see if there is any trace of the fact stated by Apollonius, as to the Babylonion knowledge of comets and the portents derived from them, we find in the opening tablet, which is a sort of summary of the contents of the work (W. A. I., Vol III., pl. 52, No. 3), the following passage. "Omens (of the) heavens from the star which before it a hairy crown and behind it a tail makes." In another fragment (W. A. I., II., pl. 49, l. 13) we have a similar description —"the star which after it a tail like a shadow makes." These show that omens of the class referred to by Apollonius were included in the work. We have, however, in

* Throughout this communication, this title will be abbreviated as W. A. I.

the series a very fine specimen of this class of tablets relating to the appearance of a comet, of which we can probably fix the date, and giving the omens which the astronomers deduced from it. This tablet is the copy of an ancient Babylonian document, and was preserved in the library of Assurbanipal (B.C. 668), at Nineveh (W. A. I., Vol. III., pl. 52, No. 1). The translation I propose is as follows:—

(1) The star rises, its rays are bright like the day.
(2) With its rays like a creeping thing, a scorpion, a tail it forms.
(3) The observation to the sight was favourable, pleasing the lord of this house, who in all the land was established.
(4) At that time (when as yet) a lord there was not in all the land.
(5) Rebellion, defection, sin, there was. A strong one exalts himself
(6) who comes forth and spreads out. The
(7) Lord of this house, and this king in his right is established—and peace and obedience in the land is.
(8) These things which from the star (are seen)—
(9) The great star from the Northern* orbit (line)
(10) To the Southern orbit
(11) In its extent, like a creeping thing a scorpion a tail makes,
(12) Turning upward. In its position at night
(13) the house of Bel it fills.
(14) These are according to the words of the tablet,
(15) When Nebuchadnezzar the king to the land of Elam went.

As this tablet was found in the library of Assurbanipal, it stands to reason that this Nebuchadnezzar cannot be the great Babylonian king, who did not rule until half a century later. We have, however, in the canonical lists of Babylonian kings and in the early historical records two kings of this name mentioned. One of these monarchs, called "Nebuchadnezzar the son of Bazi," ruled at a very remote period. There was, however, a second king of this name, who was the contemporary of Assur-ris-ilim and Tiglath Palieser I. in the twelfth century before the Christian era. This latter is the monarch to whom the omen-tablet refers, and from an inscription recently discovered by Mr. Rassam at Aboo Hubba we may certainly identify the king and possibly fix the date of the comet. From the tablet of Synchronous History (W. A. I. II., pl. 65, col. 1) we learn that in the last years of Assur-ris-ilim this monarch invaded Assyria, but, owing to the burning of his camp, he had to retreat. Soon after this the Assyrian king invaded Babylonia and defeated Nebuchadnezzar, capturing his tent furniture and the banner of his army. We may, therefore, place this even in about B.C. 1120. Among the tablets in the British Museum is the Assyrian copy of an inscription of this king's, recording his invasion of the land of Elam, which begins: "When Nebuchadnezzar, the glorious Prince, the beloved offspring of Babylon, exercised royalty"; and relates in an unfortunately fragmentary way the details of this king's invasion of Elam. In the great treasure-room or record-chamber at Abbo Hubba—the ancient Sepharvaim—Mr. Rassam found the Babylonian original of this inscription graven on a fine white marble slab, and accompanied by a series of curious mythological sculptures. The king's reign ended in B.C. 1120, or a few years later, and was, according to a small fragment, at least thirty-two years in length. The Elamite campaign took place in all probability in B.C. 1128, and was preceded by the omen of the comet. Upon this stone we have the king represented seated on his throne, and before him marches a curious figure of a Scorpio-Sagittarius. The body in the upper part is that of a man wearing the royal head-dress and drawing a bow to its fullest extent. The lower part is the body of a scorpion with elevated tail, and the legs are those of an eagle-gryphon. In the text the king assumes titles such as enable us to identify him with the monarch referred to in the omen-tablet. "The legal King, establisher of justice," "the heroic warrior," "the bearer of the strong bow," "the benefactor of men," "the protector of landmarks." Moreover, as he makes no mention of his father, we may assume he was a usurper, and, therefore, "the strong one who exalted himself." From the tablet we learn that the expedition took place in the middle of the month Tammuz (June and July). It will, therefore, be interesting to see if we can identify any comet which appeared at that time in the south-west part of the heavens during the early part of July or the end of June. Among the inscriptions which have arrived at the Museum are a number of astronomical and meteorological omen-fragments, some of which are of the greatest interest, about which I hope to send you notes on some future occasion. W. St. Chad-Boscawen.

* The Akkadian North was N.W., South, and S.E.

THE POSSIBLE SUSPENSION OF OLD AGE.*

By W. O. Dawson.

In bygone times those profound mystics and metaphysicians, the Rosicrucians, and still earlier, the Alchemists, claimed to have discovered the Elixir of Life.

They asserted that old age might be retarded, and life considerably prolonged by means of an elixir, preventing, or rather suspending, physical decay. The celebrated English Rosicrucian, Dr. Flood, whose writings became famous, is said himself to have attained the century. Modern science has recently made more startling discoveries than even those of which the Alchemists dreamed. The possibility of prolonging life has throughout all ages been deemed worthy of notice by great thinkers, amongst whose numbers the illustrious Bacon and Hufeland are enrolled. In the following article we shall endeavour to furnish our readers with the latest scientific knowledge relative to the possible suspension of old age. Imprimis—old age is of two varieties—premature, and that caused by the lapse of time. Premature age, as engendered by various mental and physical excesses, comes not within our present notice. The principal characteristics of old age, as demonstrated by anatomical research, are a deposition of fibrinous, gelatinous, and earthy deposits in the system. Every organ in the body during old age is especially prone to these ossific depositions. These earthy deposits have been found to consist principally of phosphate and carbonate of lime, combined with other calcareous salts, according to the researches of Dr. C. T. B. Williams, F.R.S. "That man begins in a gelatinous and terminates in an osseous (or bony) condition" has been truly observed by a French physician. From the cradle to the grave a gradual process of ossification is undoubtedly present; but after passing middle life, the ossific tendency becomes more markedly developed, until it finally ushers in senile decrepitude. These earthy deposits in the various organs during old age materially interfere with the due performance of their respective functions.

Hence we find imperfect circulation in the aged, owing to the heart becoming partially ossified, and the arteries

* We give this article, by the author of "How to Prolong Life" (Simpkin & Marshall), because of the interesting physiological facts on which the theory is based, and without expressing any opinion upon the theory itself. We should be rather glad to hear what Mr. Dawson recommends as the best way of counteracting the effects which he attributes to the oxygen of the air. These effects would disappear altogether if we were to cease breathing, but that seems an inconvenient way of prolonging life.

blocked with calcareous matter interfering with that free passage of blood upon which nutrition depends, so the repair of the body naturally becomes impaired thereby.

Mr. G. H. Lewes, in his luminous work, "The Physiology of Common Life," truly observes: "If the repair were always identical with the waste, life would then only be terminated by accident, *never by old age.* Both Bichat and Baillie considered that the greater number of persons over sixty suffer more or less from arterial ossification. When the heart's valves become cartilaginous, they consequently fail to propel the blood to its destinations, this fluid being further obstructed by the ossified and contracted condition of the arteries themselves.

In youth, on the other hand, nutrition is perfectly carried out, there being no blockages to impede the circulating system upon the due performance of which physical reparation depends.

Bearing the above facts in mind, we plainly perceive that the *real* change which produces old age *is, in truth, nothing more or less than a slow but steady accumulation of calcareous matter throughout the system.*

It is owing to these depositions that the structure of every organ is altered, their elasticity giving way to senile rigidity. Blockages of various organs then commence, until, at last, one of the vital organs becomes impeded, causing death. The idea that old age was brought about by failure of the so-called vital principle has long since been discarded by science. Now in reality the *true cause* of gradual disintegration in the various organs is the fact that they become inadequately supplied with blood, upon which the renovation of their structures depends.

While speaking of calcareous and osseous degenerations, that eminent authority, Dr. C. T. B. Williams, F.R.S., observes at page 252 of his splendid work, "The Principles of Medicine, "This process is there given to be viewed as almost entirely of a chemical nature, consisting in the concretion and accumulation of calcareous salts, phosphate and carbonate of lime." The *causes* of old age bring, therefore, nothing more or less than ossific deposits. We will now proceed to elucidate the principal influences leading to the condition we have described.

Having arrived at the predisposing causes of senile decay, it yet remains for us to go still further, and seek out their origin. The two principal sources of old age are fibrinous and gelatinous substances; secondly, calcareous depositions. According to the recent researches of Mr. de Lacy Evans, the origin of the former may undoubtedly be traced to the destructive action of atmospheric oxygen, and this proposition is demonstrated by the following argument.

In the air we breathe, the relative proportions of oxygen to nitrogen are 22 to 78. Although oxygen is in far smaller bulk, yet it is the most active element. Now, oxygen has an affinity for every other element except fluorine, thereby forming the oxides. Oxygen plays by far the most important part in those chemical changes constantly at work within the animal economy, life itself being but a constant waste by oxidation, and reparation by food. In the blood exists albumen and fibrine, themselves resolved into component elements—carbon, hydrogen, nitrogen, oxygen, sulphur, and phosphorus. Fibrine has been said to contain 1·5 per cent. more oxygen than albumen. Now, oxidation converts albumen into fibrine, fibrine itself being but an oxide of albumen.

Although unquestionably fibrine nourishes the organs of our bodies by repairing their waste, *yet a great deal of this substance accumulates in course of time, lessening the calibre of the blood-vessels, and thereby causing their induration.*

It therefore follows that, as time goes on (old age), fibrinous and gelatinous depositions become noticeable. Consequently, as fibrine is an oxide of albumen, so also is gelatine an oxide of fibrine, due to the action of oxygen on the fibrine deposited by the blood. A further effect of oxidation causes part of these substances to be decomposed, and subsequently eliminated through the kidneys as compounds of ammonia and urea. There is always a continual struggle progressing in our systems between accumulation and elimination. Thus it is that the fibrinous and gelatinous accumulations of old age are chiefly traceable to the chemical action of atmospheric oxygen.

The calcareous deposits next claim our attention, being proved by anatomical investigation to be peculiarly characteristic of old age.

In the human body water forms 70 per cent. of its aggregate weight, in fact there is not a single tissue which does not contain water as a necessary ingredient. Now water holds certain salts in solution, which become more or less deposited, notwithstanding the large proportion eliminated through the secretions. Nevertheless it is only a matter of time before these minute particles deposited by the blood have a marked effect in causing the stiffness and aridity of advancing life. The reason why in early life the deposit of earthy salts is so infinitesimal is simply because they have not had time to accumulate. It is the old kitchen boiler which is found full of incrustations, not the new one, time not having been sufficient for their deposit. M. Le Canu proved by analysis that human blood contains compounds of lime, magnesia, and iron, averaging 2·1 in every 1,000 parts. This clearly demonstrates that in the blood itself are contained the earth salts, which gradually become deposited in the system.

Blood being made from the assimilation of food, it is therefore to food itself we must primarily look for the origin of these earthy deposits. Besides providing the requisite elements of nutrition, food contains calcareous salts, which, upon being deposited in the arteries, veins, and capillaries, become the proximate cause of ossification and old age. Mr. G. H. Lewes says with truth in his "Physiology of Common Life," "Moreover, in food we are constantly introducing different substances which produce variations in the nutrition of the parts. These differences *accumulate* their influence in those changes named ages, and they culminate in the final change named death."

Having now traced the primary existence of calcareous matter *to food itself*, it is consequently a subject of no small moment to ascertain those varieties of dietetic articles containing these salts. As a matter of fact, everything we eat does contain them to a greater or less degree. The cereals have been found most rich in earth salts; so bread itself, the so-called staff of life, except in great moderation, assuredly favours the deposition of these salts in the system. The more nitrogenous our food, the greater its percentage in calcareous matter; thus a diet composed principally of fruit, from its lack of nitrogen, is best adapted for suspending ossific deposits. Moderation in eating must ever be of great value as an agent for retarding the advent of senility. Large eaters more rapidly bring about these ossific deposits, owing to having taken more food into the stomach than it is able to utilize or excrete, the result being naturally a more rapid blockage. According to the researches of Mr. de Lacy Evans it would appear that the following articles of food contained least of the earth's salts:—1st. Fruits (chiefly owing to their lack of nitrogen). 2nd. Fish and poultry. 3rd. *Young* mutton and veal. Old mutton and beef from age contain a large quantity of earthy matter.

It becomes self-evident, therefore, that living moderately and as much as possible on a diet containing a *minimum amount of earthy* particles is clearly most suitable in order

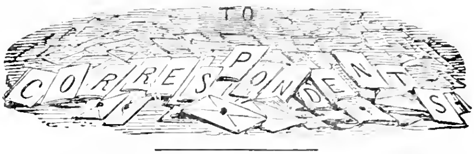
to retard old age and thereby prolong existence. The most rational treatment with a view to retard old age is in the first place to endeavour as far as possible to *counteract* the excessive action of atmospheric oxygen; secondly, to retard the deposit of ossific matter and as far as possible to dissolve partially-formed calcareous concretions. Distilled water and diluted phosphoric acid are believed by Mr. de Lacy Evans to have the desired effect. When considering their special action we cannot but fully coincide with him as to their efficacy in retarding old age by their combined chemical action. Now distilled water alone has a powerful action owing to its solvent properties, thereby dissolving and excreting the excess of earthy salts which otherwise would become blocked up in the system, gradually storing up those blockages which in time cause old age. The solvent properties of distilled water are so great *per se* that on distillation in vessels it actually dissolves small particles of them. Now the generality of waters contain more or less carbonate of lime, and are to be avoided, especially those from chalky soils, tending as they do to produce calcareous deposits. The action of distilled water as a beverage is briefly as follows:—First, its absorption into the blood is rapid; second, it keeps soluble those salts already existing in the blood, thereby precluding their undue deposit; third, it facilitates in a marked degree their elimination by means of excretion. After middle life *a daily use of distilled water is highly beneficial* to those desirous of retarding old age, and it is also a useful adjunct for adverting stone in the bladder and kidneys.

Lastly we have to deal with the special beneficial action of diluted phosphoric acid when mixed with distilled water and consumed *daily*. If well diluted with distilled water it is perhaps the most powerful means known to science for suspending old age. Diluted phosphoric acid possesses the following great merits:—It prevents the accumulation of earthy salts and also facilitates their elimination. Secondly, by its great affinity for oxygen those fibrinous and gelatinous deposits previously alluded to are held in abeyance by its use. Thus by its *double* agency, combined with distilled water, we have a most valuable preventive against the *primary* causes of old age, which its daily use holds in check. Hypophosphites are believed to exercise a like action, as on becoming phosphates through fixing the oxygen from the blood, undue oxidation (waste of the tissues) is to a great extent prevented.

To sum up shortly what has already been advanced, according to the teachings of modern science the most rational and certain means of retarding old age are by avoiding all foods rich in the earth salts, and by taking *daily* two or three tumblerfulls of distilled water with about 10 to 15 drops of diluted phosphoric acid in each glassful. Thus are the inimical salts held in solution and their excretion daily effected. The means herein advocated have also another great advantage, viz., that they cannot possibly do any harm.

Sub-Editorial Gossip.

Next week the sunrise and sunset column for January, in Whitaker's Almanac, will be discussed and explained. During the next month two zodiacal maps will appear, one showing the sun's course from day to day in January, the other the sign of the zodiac which souths in the middle of the night in January. Pictures will also be given showing the positions of the planets throughout the year 1884. The zodiacal maps will be continued monthly—two in each monthly part, and also the discussion of the details presented in Whitaker's Almanac. It is hoped further that space may be found for a series of monthly star-maps showing the constellation figures, accompanied by Admiral Smyth's curious descriptions of the constellations.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

STRANGE LAKE WAVE.

[1065]—On reading in Knowledge, No. 111, the letter (1043) from Port Louis, it occurred to me that the following extracts from a letter written in December, 1792, by the well-known William Creeh, of Edinburgh, and published in the "Edinburgh Fugitive Pieces" (ps. 119 and 121), might interest your readers:—

"In 1782, at the time of the dreadful earthquakes in Calabria, the mercury in the barometer in Scotland sunk within the tenth of an inch of the bottom of the scale; the waters in many of the lochs or lakes in the Highlands were much agitated."

"Upon the 12th of September, 1784, a very extraordinary phenomenon was observed at Loch Tay. The air was perfectly calm, not a breath of wind stirring. About six o'clock in the morning, the water at the east end of the loch ebbed about 300 feet and left the channel dry. It gradually accumulated and rolled on about 300 feet further to the westward, when it met a similar wave rolling in a contrary direction. When the waves met, they rose to a perpendicular height of five or six feet, producing a white foam upon the top. The water then took a lateral direction southward, rushing to the shore, and rising upon it four feet beyond the highest watermark. It then returned, and continued to ebb and flow every seven minutes for two hours, the waves gradually diminishing every time they reached the shore, until the whole was quiescent. During the whole of that week, at a later hour in the morning, there was the same appearance, but not with such violence."

I need scarcely add that Loch Tay is about fourteen miles long and one mile broad at the widest part, having the village of Killin at the west end and that of Kenmore at the east. I could give traditions of other interesting phenomena, showing some connection with earthquakes, but must not occupy your valuable space.

Charles Stewart.

STRANGE SUNSETS.

[1066]—Referring to letters in last two numbers of Knowledge respecting the above, will you kindly allow me to add that here in the West of England we have witnessed it at sunset and also at sunrise? Of several displays I note particularly:—

Date. 1883.	Sunrise.	Sunset.
Nov. 8	....	Glare, reddish fog.
,, 24	Lurid sky	The whole sky lurid.
,, 29	....	Deep red glare.
,, 30	The whole sky blood-red	Singular red glare east and west
Dec. 2	....	Deep red, especially N.W.

The first few observed gave me the idea of an auroral display with (sometimes) rays wide and feebly developed, concentrating towards sun's place as a centre.

I further note that the weird glare attains its maximum brightness about $1\frac{1}{4}$ hours before sunrise and after sunset, that it dissipates quicker than it gathers, that a diffused (and shifting) but

brighter portion appears about E.S.E. in the mornings, and W.N.W. in the evenings, at an elevation between 20° and 30°. In addition to descriptions given in above letters, I understand that at Trinidad (practically the antipodes of Ceylon) the sun's "face" at rising was "bluish," and about setting time "distinctly blue." Surely the "sulphurous vapours" from the recent Krakatoa eruption cannot be the cause of these singular appearances, comparing Krakatoa (as it was) and the quantity of vapoar, &c., emitted, with the enormous area over which the singularly beautiful appearances have been seen.

Sun-spots have been at times numerous, and at others very few, during the last two months. Can any spectroscopist enlighten us as to recent state of protuberances, &c.? THOS. RADMORE.

SHOWER OF PERCH—SUNSETS.

[1067]—Being a constant reader of your valuable journal, I enclose the cutting from to-day's Edinburgh *Scotsman*, of rather a peculiar phenomenon witnessed in Airdrie, viz., a shower of live perch, last Saturday morning, Dec. 15. Now, perch never, or rarely, swim near the surface of the water, and, if drawn up by a whirlwind, it must have been an extra strong current to have drawn them from deep water.

I have been much interested in the papers on the beautiful sunsets lately seen all over the country. I was in Edinburgh last evening, and saw a most peculiar sunset. I watched it from 4 o'clock until 5 o'clock, and it varied from grey to green, then red to a copper colour, then a fiery or blood-red colour. It was a grand sight. I have seen a great many of those peculiar sunsets.

Glasgow, Dec. 17. JOHN A. STEWART.

STRANGE PHENOMENON.

[1068]—Seeing so many meteorological phenomena in your excellent paper, KNOWLEDGE, I am tempted to ask for an explanation of the following, which I saw when on board the British India Company's steamer *Patna* while on a voyage up the Persian Gulf. In May, 1880, on a dark, calm night, about 11.30 p.m., there suddenly appeared on each side of the ship an enormous luminous wheel whirling round, the spokes of which seemed to brush the ship along. The spokes would be 200 or 300 yards long, and resembled the birch rods of the dames' schools. Each wheel contained about sixteen spokes, and made the revolution in about twelve seconds. One could almost fancy one heard the swish as the spokes whizzed past the ship, and, although the wheels must have been some 500 or 600 yards in diameter, the spokes could be distinctly seen all the way round. The phosphorescent gleam seemed to glide along flat on the surface of the sea, no light being visible in the air above the water. The appearance of the spokes could be almost exactly represented by standing in a boat and flashing a bull's-eye lantern horizontally along the surface of the water round and round. I may mention that the phenomenon was also seen by Captain Avern, commander of the *Patna*, and Mr. Manning, third officer. LEE FORE BRACE.

P.S.—The "wheels" advanced along with the ship for about twenty minutes.—L. F. B.

LARGE METEOR.

[1069]—I had the good fortune to see the large meteor, on Nov. 28, and as "Excelsior" would like to have observations from other parts I thought I would send mine. I was observing Saturn with a $2\frac{1}{4}$-in. achromatic when I saw the meteor cross the field of view, and looking up I saw it passing overhead. I was too startled to note the time it occupied, or the very colour; but I noticed particularly the place of disappearance, which was about half a degree west of Gamma Ursa Minoris. Henry T. Vivian writes as follows in *English Mechanic*, Dec. 14. "At 10.35 a brilliant white fire-ball became visible between Xi and Eta Draconis at about a third of their distance from the former star, and made a direct course towards the horizon, leaving in its wake a train of small sparks. It vanished about 15° above the horizon." STARGAZER.

Mexboro' Common, near Rotherham.

LUNAR PHOTOGRAPHY FOR SMALL TELESCOPES.

[1070]—The following method requires neither clockwork nor camera, and gives fair results, interesting to the worker, if not scientifically valuable.

Buy a shilling glass-cutter and cut up a Wratten Gelatine "Instantaneous" $\frac{1}{4}$-plate into small squares with the corners rounded off such as will go inside your lowest power eyepiece and rest on the diaphragm; remove the lenses, screw on a solar dark glass, and use the eyepiece as your dark back; find the visual focus roughly with a piece of ground glass or tissue paper, and find the actinic focus by trial, as described by Mr. Brothers in an early number of KNOWLEDGE. The exposure is made as short as possible by holding a piece of millboard close in front of the object-glass, whipping it away and instantly replacing it. A tenth of a second is quite enough if a strong developer be employed. Of course, due photographic precaution is necessary throughout. The moon's motion during the exposure is less than 2″, a quantity quite inappreciable in such a photograph. A silvered glass reflector makes the method even simpler. H. L. C.

AN ALARMING INCIDENT.

[1071]—Though in the present day of scientific discovery and iron ships, the electric flash has lost many of its terrors, the incident of a vessel being struck by lightning still remains one of the most startling and alarming events that can be met with at sea. This is especially the case when the weather is clear and moderate, and the blow falls in the darkness of the night or of the early morning in the open seaway, for then, not only is danger least expected, but the anxiety and alarm which such an occurrence would naturally inspire at any time must necessarily be prolonged and exaggerated by the difficulty of ascertaining whether any damage has been done or not. It was under such circumstances that the fine screw steamer *Southgate*, of London, was struck last September, whilst on her way, laden with grain, and homeward bound, through the Black Sea from Odessa, and though no permanent harm was inflicted, the feelings of anxious doubt and uncertainty that for a time had place on board can be more easily imagined than described.

At one o'clock in the morning, those who were below were suddenly roused from their sleep by the sound of a fearful crash upon the steamer's side, which, making her shiver and tremble, rang out on the iron like the blow of a heavy hammer. Then quickly followed two other blows, or seeming blows, much weaker than the first, as if some object in the way were being grazed upon. It does not need a sailor to understand how fraught with dangerous meaning such an event must be to the voyager, whose life depends on the soundness of the thin walls of the modern merchant steamer, and sudden as was the waking, and quickly as the blows succeeded one another, the last report had hardly died away when the captain was on deck, looking round in every direction, but in vain, for something to account for the alarming sounds. Strangely as it then appeared, though they had seemed to come from the starboard quarter (*vide* note), just in front of him, there was not a sign of anything unusual to be seen or heard. The heavy rain pattering on the planks, the splash of the waves against the sides, and the regular rattling of the screw alone broke the stillness of the night; and a glance over the bulwarks showed no issuing grain from rent plates, no wreckage telling of a vessel run down, no surf marking the place of an unknown rock.

The true cause, however, did not long remain a mystery, for when he reached the bridge, feeling the deck warm to his bare feet as he went, he found the chief officer just recovered from the stunning effects of an electric flame that had fallen on the steamer in a sudden stream, as the lightning, which all the evening had been continually playing in the heavens in bright floods of thunderless light, passed over her in its course across the sky from west to east. To the startled watchers, it had seemed as though the masts were rattling down around them as the glowing fire poured along the bridge, and over the deck beneath, until it burst on the starboard side with a loud report, which, followed quickly by two sharp thunder-claps, accounted for the sounds that had been heard below. It was but for a moment that the steamer was enveloped in light, and then all was dark and quiet again, though there was little rest for any one on board until a careful search disclosed the comforting fact that not even a mark remained to show the course of the dangerous stream.

From the various accounts of the event the writer heard the following day, he was surprised to gather that the flash, instead of striking the iron masts in the first place and passing along the iron stays to the sides, as might have been expected, appears to have fallen on the water or the stern, and then to have risen over the steamer, for the men who were on the forecastle at the time described the flame as coming up from the sea, whilst some who were hoisting a staysail farther aft, felt it as a hot breath moving in the direction of the stern. It may also be worthy of note that all, whether in the forecastle or in the after cabins, heard the sounds as if the blow had been struck in their immediate neighbourhood, though always on the starboard side.

The incident occurred about latitude 42° 26′ N., and longitude 29° 13′ E. J. TYRRELL BAYLEE.

NOTE.—The starboard quarter is the right hand side, looking from stern to stem, at the stern of a vessel.

TRICYCLES.

[1072]—A correspondent asks for Mr. Browning's opinion on the Omnicycle—may I be allowed to add mine? This year I wished to purchase a tricycle to enable me to recruit health and strength and to be out in the air as much as possible. I had passed through a year of hard work and anxiety; my walking powers were very poor; after a careful examination of the Omnicycle, the "Challenge," the "Imperial Club," and the "Cheylesmore," I decided on the former, and I was delighted with my choice, and I would strongly recommend it to any one who, like myself, wished for a machine in the sense of a tonic. I cannot say much for speed, as I contented myself with six miles an hour; but it was easy to work, the simple up-and-down motion being a little less fatiguing than the rotatory pedal movement. Then, for climbing hills, in my opinion it has no equal. Of course, my experience is limited, but I feel bound to speak highly in its favour. A Medical Man.

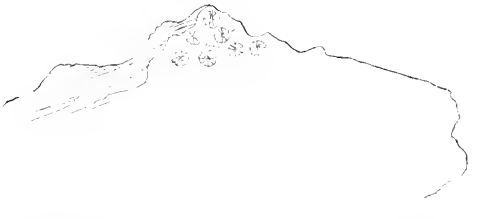
THE OMNICYCLE.

[1073]—In answer to your correspondent, Mr. J. A. Ollard, I can give some information, and should be glad to receive some concerning this tricycle. 1. A rev. gentleman, on whose statement I can depend, informed me that in September last, in the Scotch Highlands, he did 80 miles a day with ease, and that in the week before he wrote me he did 224 miles in four days on the machine in question. Further, he adds: "It is a capital hill-climber; I can go down a gentle slope at twelve miles an hour, and on a good level road ten miles." 2. I should be glad to receive information as to the durability of the working-gear, chains, &c., of the machine from any one who has had some experience of it.

The boxes or cylinders on which the chains work should manifestly be covered up in some way, in order to keep the latter in good order, and to keep them from wet, dust, and mud. The machine has the special advantages that it can be wrought with any length of stroke, has no "dead point," and that it can be started with the treadles in any position. I suggested the obvious, and I think necessary, improvement of covering the cylinders and chains to the makers, as I wished to see that improvement made before buying; but I received no definite answer. W. Hay.

FIND AT BLACKFRIARS.

[1074]—Just a word for your readers, amongst whom I number one. A son of mine in his dinner-hour has wandered on the banks of the Thames at Blackfriars, and has there found many bowls of tho very old-fashioned clay pipes, and also specimens of what appears to me to be a kind of coral. It has, as I am now looking at it, a surface as follows, and the apertures descend at least $1\frac{1}{2}$ in.



Is not this rather novel? The coral resembles quartz more than anything else. E. B. Williams.

GROWTH OF NAIL.

[1075]—Six weeks ago I hurt the nail of the first finger of the right hand, and having before noticed from other marks the nail growing, I took means to find out the rate at which it grows. It may be interesting to some of your readers to know the result. I measured the distances each week from the spot to the "quick," taking this latter as a constant position. On July 13, it measured 8 millimètres; on the 20th, 6 mm.; the 27th, $4\frac{1}{2}$ mm.; August 3, 3 mm.; 10th, 2 mm.; 17th, 1 m.; and 24th, entered on a line with the "quick."

From these data, we find that the nail grew $\frac{31}{100}$ of an inch in six weeks, and would take, if it continued to grow at the same rate, just over nineteen weeks to grow an inch, that is, during a year, 2·7 inches. Robert F. Martin.

WEATHER WISDOM.

[1076]—I remember seeing in Knowledge a note intimating that the writer (Mr. J. A. Westwood Oliver, I think) was about to publish a book on "Weather Wisdom," and desiring to hear of any "sayings" thereanent, of which he might not be aware. I have had no means of knowing whether he has published his book yet, but I wonder if he possessed "The Shepherd of Banbury's Rules to Judge of the Changes of the Weather, Grounded on Forty Years' Experience, to which is added a Rational Account of the Causes of such Alterations; the Nature of Wind, Rain, Snow, &c., on the Principles of the Newtonian Philosophy; by John Claridge (1765)."

Observation V., for instance, is "If small clouds increase—much rain"; and in the book, which contains twenty-six "Observations," each with an elaborate "Account" (often with classic references) the following occurs incidentally:—

Janiver freeze the pot by the fire.
If the grass grow in Janiveer,
It grows the worse for't all the year.
The Welshman had rather see his dam on the Beir,
Than to see a fair Februeer.
March wind and May sun
Makes clothes white and maids dun.
When April blows his horn,
'Tis good both for hay and corn,
And April flood
Carries away the frog and her brood.
A cold May and a windy
Makes a full barn and a feudy.
A May flood never did good.
A swarm of bees in May
Is worth a load of hay;
But a swarm in July
Is not worth a fly.

If woolly fleeces spread the heav'nly way
Be sure no rain disturbs the summer day.

In the decay of the moon
A cloudy morning bodes a fair afternoon, &c., &c.

Whiteinch, 1883. W. W.

LETTERS RECEIVED AND SHORT ANSWERS.

B. B.—Lee Fore Brace—E. Brown. Pressure in barometers does not act through the glass.—E. Cannon—H. J. Wykes. Know of none.—W. Gibson. The problem is this. Having given the edge of a cube, to determine by a geometrical construction with the aid only of straight line and circle the edge of a cube which shall be of twice the volume. Of course, any one can *draw* such a line, the length of which may be determined in hundreds of ways. But the geometrical construction in accordance with the conditions named is impossible.—E. A. F. Meteors (including falling stars) are bodies reaching our air from interplanetary space, rendered luminous in their rush through the air. The recent sunsets due probably to meteor dust in upper air.—S. A. Boyd.—S. B. V. There is no reason for supposing the British nation akin to the lost ten tribes. The paradox is an old one, and ought to be, but is not, worn out.—Orrell. Know none.—J. E. Harris. Earth revolves round sun, and earth rotates on its own axis.—H. Clark. See last two or three numbers.—E. S. Marsh—Uncertain. I admit the interest residing in the questions you raise: but it would kill Knowledge if every correspondent with interesting ideas about the natural and the supernatural were dealt with either here or in the open part of the correspondence column. It might probably kill the Editor of Knowledge if he entered into such discussions, however interesting, with all who invited him to do so. He must leave this to those who take interest in such matters. F. C. Collins. Fear no room. *Do* more play at draughts than at chess?—W. M. Harman—M. F. W. Ernst Groth, M.D. Thanks; the extracts you have kindly sent suffice to show that the theory is bosh.—J. M. G. The moon is more drawn to the sun than to the earth, yet the earth and moon do not part company. Try the effect of considering not the actual pull of Mars on a particle upon his nearest satellite, but the difference between his pull on any particular particle and his pull on the satellite as a whole. J. H. Garth. Reflecting matter high up.—Greenware. Thanks; but your observation could not be used for calculation of real path. Pax. Author could not venture advice.—S. E. I think Dr. Carpenter has written such a work. Image inverted.

Letters Received.—E. A. C., S. H., [illegible], Squid, G. E. H.

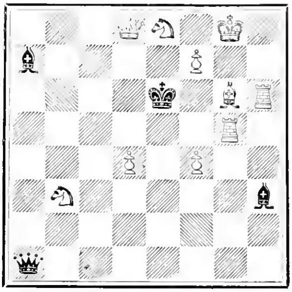
Our Chess Column.

By Mephisto.

OUR CHRISTMAS BIT.

(Great Tragic Pantomime, in which the White King commits suicide after having all his men slaughtered.)

Black.



White.

White to play and self-mate in nine moves.

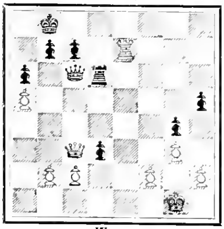
By G. Laws.

How it's Done.

1. Kt to B5 (ch)	1. B takes Kt
2. P to B8 (Kt) (ch)	2. B takes Kt
3. B to Kt sq (disc ch)	3. B takes R
4. Kt to Kt7 (ch)	4. B takes Kt
5. R to K5 (ch)	5. B takes R
6. P to B5 (ch)	6. B takes P
7. B to R2 (ch)	7. Q takes B
8. P to Q5 (ch)	8. Q takes P
9. Q to K7 (ch)	9. K takes Q, mate

The following two positions occurred in games played at Stockton-on-Tees by Mr. Blackburne (presumably at a simultaneous performance) :—

Mr. Appleton.
Black.

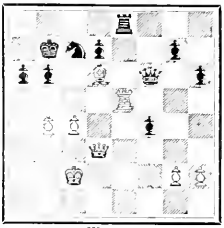


White.
Mr. Blackburne.

White. Mr. Blackburne.	Black. Mr. Appleton.
34. Q to Kt8 (ch)	K to R2
35. R to K8	P to Kt3 (*a*)
36. P takes P (ch)	P takes P (best)
37. R to K7 (ch)	R to Q2
38. Q to K8 (*b*)	R takes R
39. Q takes Q	P to Q7
40. Q to Q6	R to K8 (ch)
41. K to Kt2	P Queens

White draws by check on B7 and B8.

Mr. Appleton.
Black.



White.
Mr. Blackburne.

White. Mr. Blackburne.	Black. Mr. Appleton.
40. B takes Kt	R takes R
41. B takes R	Q takes B
42. Q takes P (ch)	Q to B2
43. Q takes Q	K takes Q
44. K to Q3	K to Q3
45. K to K4	P to KKt4
46. K to B5	P to QKt4
47. P takes P (*c*)	P takes P
48. P to R4	P takes P
49. K takes P	K to Q4
50. K to Kt4	K to B5
51. K takes P	K takes P

And Black won.

NOTES.

(*a*) White threatens R to R8, mate. If Black played the likely-looking move of Q takes R, White would draw by 36. Q takes Q, followed, if P to Q7, by 37. Q to K3, and draws by perpetual check. But if instead of P to Q7. P takes P, then 38. Q to K3 (ch), P to Kt3 (the only hope of escaping a perpetual check). 39. P takes P, K to Kt2. 40. K to Kt2 (best), R to QB3. 41. Q to B sq, P takes P, and White has the better chance. He will proceed by first playing P to B4, and then bringing the K round to Q2 or Q3, and playing P to Kt3, in which case the Black K cannot move into check, as White would play K to B sq. White might then advance his P on the K side. Black would require the utmost care to effect a draw (if that be possible).

(*b*) A very fine move to which there is no good reply.

(*c*) If 47. P to B5 (ch), K to B3. 48. K to Kt6, Black will win by P to QR4.

The Great Sea-Wave.—In the life history of a planet, says Mr. Proctor, there are three stages—a fiery youth, a cool, sedate, and orderly maturity, a sapless and withered old age. Jupiter is just now in the first of these stages, the earth enjoys the second, the moon has degenerated into the third. Without disputing the general theory I take leave to doubt whether Mr. P. has correctly classed the earth. The habits of our planet are still distressingly irregular. In the Strait of Sunda during the last week chaos has literally come again. Subterranean fires have belched forth, sea and sky have been mingled, and of the dwellers in those parts a tidal wave has overwhelmed, it is reported, no less a number than 75,000. This wreckage of human life will perhaps be little accounted of in a region where, as De Quincey remarks, man is a weed. An even greater catastrophe befell in India about 60 years ago, when the Runn of Cutch, 2,000 square miles in area, sank suddenly below the sea with its whole population. The multitudinous East hardly recognised the loss, and in the present case will be barely conscious of the calamity of the 75,000. To my mind this wholesale destruction suggests a doubt whether the planet has yet fairly reached the habitable stage. It is quite clear that the fires of its choleric youth have not burnt themselves out. The sympathetic earthquakes in Queensland, South Australia, and Tasmania which have followed the Java disturbance hint the possibility of further irregularities—perhaps in Cook's Strait, which, like the Strait of Sunda, is an old geologic fracture, and consequently the natural breeding-ground of earthquakes. I apologise for making so uncomfortable a suggestion, especially whilst the Houses are still in session and all the wisdom of the country is collected at Wellington. I apologise for the suggestion, yet I do not exactly take it back. In a planet so young as ours is, and consequently so capable of playing its inhabitants a scurvy trick, it is not altogether wise to plant your seat of Government in the crack of an old geologic fracture.—*Otago Times.*

Contents of No. 112.

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